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Popular Mechanics

WINDOWS 98 HANDS-ON REPORT

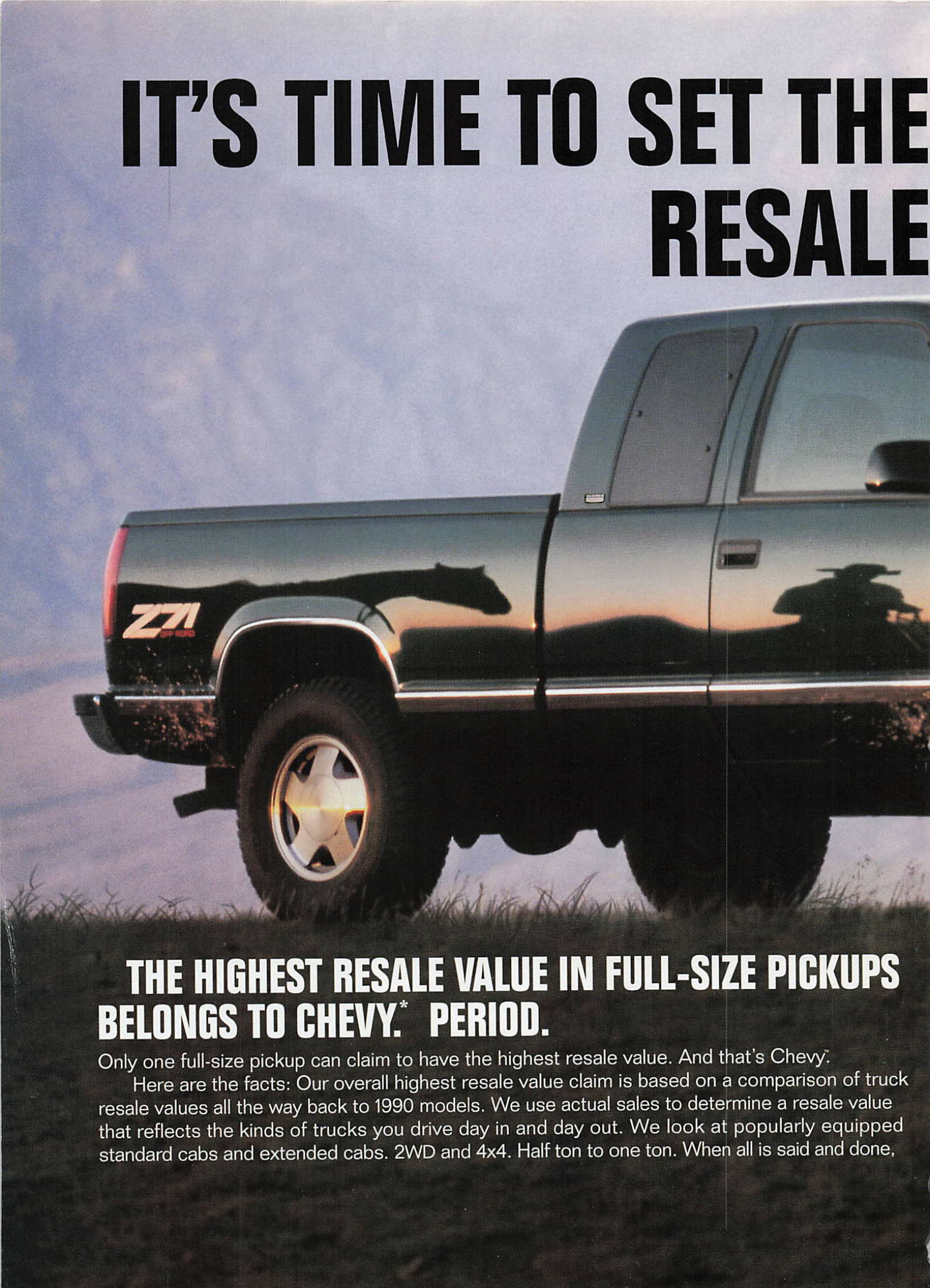
TESTING THE FASTEST MODEMS YOU CAN BUY

SPEED MODEMS! 56K

CHOOSING THE RIGHT GLUE FOR ANY REPAIR

NEW LIFT POWER FOR MAGLEV TRAINS

IT'S TIME TO SET THE RESALE

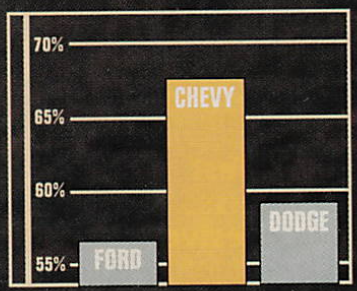


THE HIGHEST RESALE VALUE IN FULL-SIZE PICKUPS BELONGS TO CHEVY.* PERIOD.

Only one full-size pickup can claim to have the highest resale value. And that's Chevy.

Here are the facts: Our overall highest resale value claim is based on a comparison of truck resale values all the way back to 1990 models. We use actual sales to determine a resale value that reflects the kinds of trucks you drive day in and day out. We look at popularly equipped standard cabs and extended cabs. 2WD and 4x4. Half ton to one ton. When all is said and done,

RECORD STRAIGHT O
VALUE.



who returns more of your hard-earned money when you sell your full-size pickup? Compare: Chevy retains 67.6% of its original value. Dodge keeps 59.2% and Ford, 56.8%

So here's a simple rule to remember: the highest resale value in full-size pickups belongs to **Chevy. The most dependable, longest-lasting trucks on the road.†**

Chevy Trucks

LIKE A ROCK

1-800-950-2438 or www.chevrolet.com

*Based on MSRP vs. trade-in values of 1990-96 models. Source: National Auto Research Black Book Official Used Car Market Guide. Excludes other GM products. †Dependability based on longevity: 1981-1996 full-line light-duty truck company registrations. Excludes other GM divisions. Z71 is a registered trademark of the GM Corp. ©1997 GM Corp. Buckle up, America!

Popular® Mechanics

May

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VOLUME 175, NO. 5

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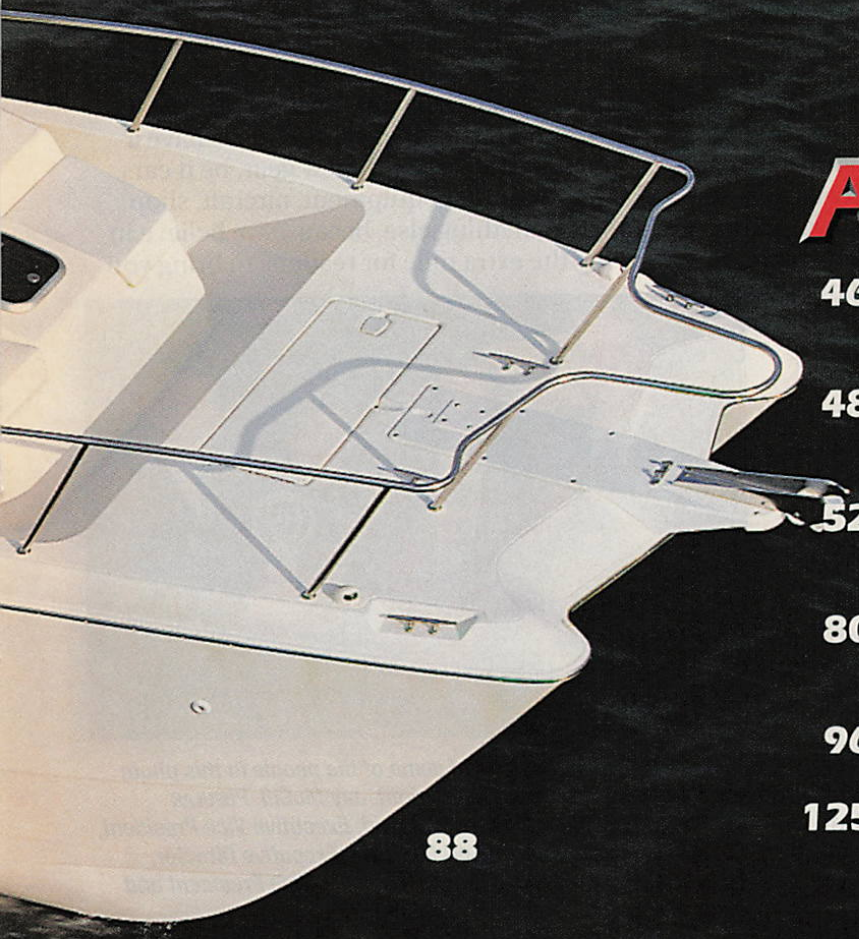

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COVER PHOTO BY MICHEL TCHEREVKOFF
BACKGROUND PHOTO BY FOREST JOHNSON

Editor's Notes

An Issue Of Tests

Enormous doings recently at the National Automobile Dealers Association convention, where POPULAR MECHANICS once again had the privilege of sponsoring the annual Automotive Hall Of Fame Awards Luncheon. Among other awards presented was our Honored Marque Award for 1998, which we gave to Ford Motor Co. in recognition of the 50th anniversary of an American icon—the F-Series pickup. On hand to accept for Ford was good buddy Jac Nasser, President of Automotive Operations. What more deserving nameplate could there be? Think about it. Best-selling vehicle in America, car or truck, for the past *16 years in a row*. It's an incredible record that won't be equaled any time soon.... **What makes the F-Series pickup,** or any of the other top-selling cars and trucks, so popular? Are they the best built? The fastest? The most luxurious? The best value? We wanted to know, too, so we gathered up an F-Series pickup and the other nine best-selling vehicles for 1997 to see what really makes them so appealing to American car consumers. To find out what we found out, turn to page 80.... **This edition of POPULAR MECHANICS turned out to be an issue of tests.** On page 104, you'll find our comparison test of string trimmers, a tool no homeowner should be without. Then on page 72, our cover story is a laboratory-and-real-world comparison test of the newest, lightning fast 56K computer modems. Lastly, beginning on page 88, we test and compare six of the newest power catamarans. Why all this emphasis on testing? Why don't we just publish a photo and press release supplied by the manufacturer when something new comes out—as many other magazines do? Because that's just not the way we do it here at POPULAR MECHANICS. We're a hands-on magazine and we have a hands-on staff. We test new gear, be it cars, boats, computer equipment, aircraft, shop tools or anything else, because we believe in going the extra mile for readers, to bring you the information you want and need to make an intelligent buying decision. We don't just tell you what's new, we also tell you what's good. We've been doing it for 96 years and plan to continue doing it for the next 96. Then we'll see. End of speech.... **This is the first issue with our new look.** It's meant to make reading POPULAR MECHANICS easier and more fun. Hope you like it. Till next time.

PHOTO BY SUSIE LEVINE'S PHOTOGRAPHY

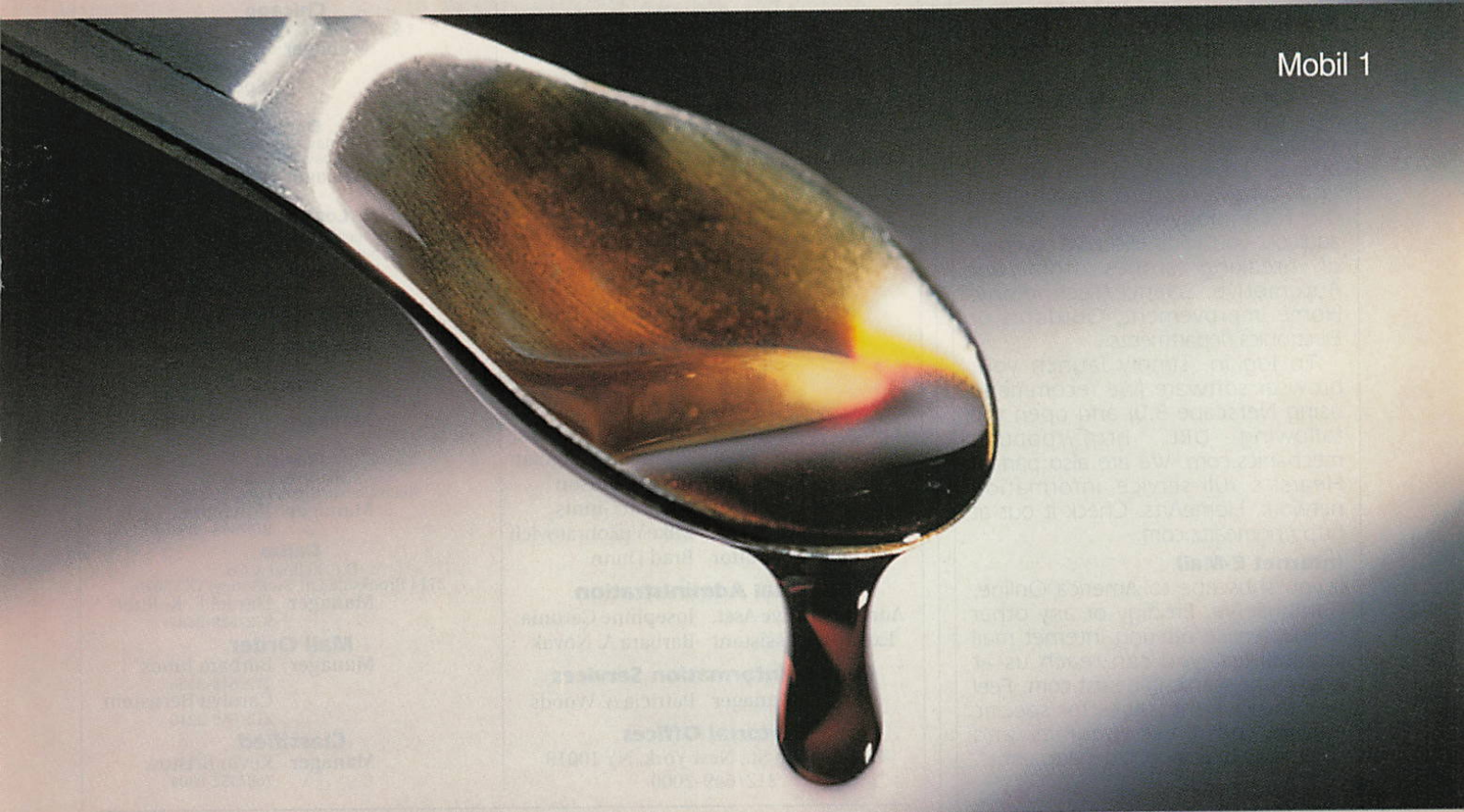
Jac Nasser (right), President of Ford Automotive Operations, accepts the PM Honored Marque Award.

PHOTO BY A. GREG ALTER

Last month, the affiliations of some of the people in this photo were misidentified. From left to right, Jay McGill, POPULAR MECHANICS Publisher; Richard Weigand, Executive Vice President, Saatchi & Saatchi Pacific; Lori McNeely, Executive Director, Tread Lightly; and Dave Illingworth, Senior Vice President and General Manager, Toyota Motor Sales Inc.

Technology Editor Tobey Grumet compares modems with Alex Nikish, Project Manager at the National Software Testing Laboratories.

Joe Oldham



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We're trying to make it easier for you to communicate with us. Here are some ways you can do it.

LETTERS

Your written letters are always welcome. If we think your letter would be interesting to other readers, we might even print it in our Letters column (unless you request that it not be printed). Send your letter to one of our editors, who are listed by department on the masthead to the right. Our address is: Popular Mechanics, 224 W. 57th St., New York, NY 10019.

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If you have access to a fax machine, you can fax correspondence to us. Our fax number is 212/586-5562, and it's available 24 hours a day.

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Computer users with a connection to the World Wide Web can log into our Web site, The PMZone. There are more than 10,000 text, graphics, software and digital movie files to browse through. Every day, you will find a new feature drawn from the Technology Watch section. In addition, you'll find exclusive coverage of breaking stories from our Automotive, Science/Technology, Home Improvement, Outdoors or Electronics departments.

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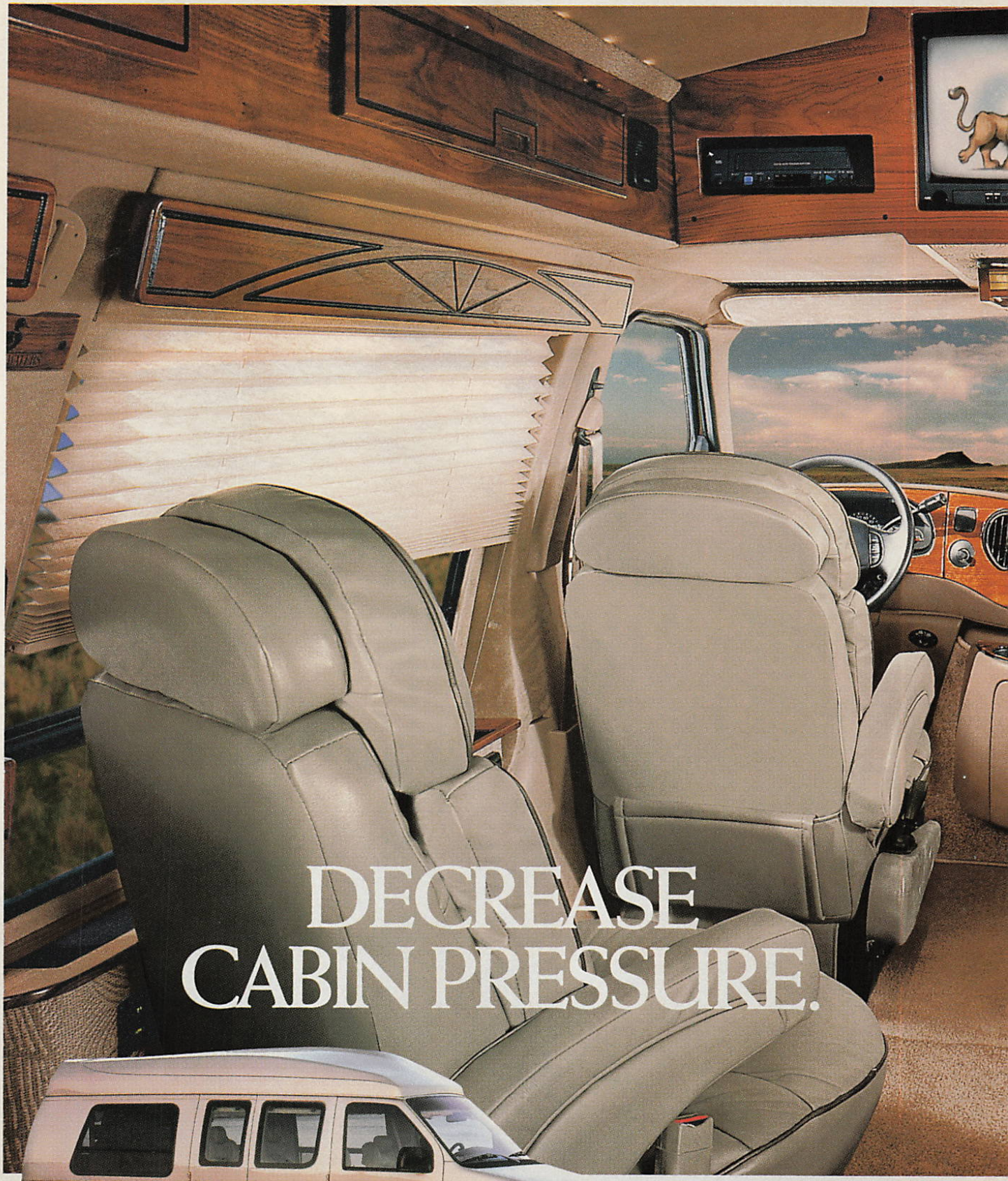

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* Always wear your safety belt and secure children in the rear seat.

Letters

Volcano Tamers

Popular Mechanics
1998 MOTORCYCLE GUIDE
VOLCANO TAMERS
An Elite Group Of Scientists Stands Between A Half Billion People And The World's Most Dangerous Volcanoes
ACTION ON THE INTERNET
Video Streaming Cuts Download Lag
REVOLUTION IN SPORTS TV
New System Creates Replays From Unbelievable Angles

How arrogant of you to think that puny humankind can change the course of nature and actually exert control over something like a volcano. It may work for a while, but forget it over the long haul. Just ask people living along the banks of the Mississippi.

CHARLES JUDSON
VIA INTERNET

Bigger Than Big

You incorrectly described the Euclid 260 as the world's biggest truck. That distinction has belonged to the Komatsu Haulpak 930E since its unveiling in 1996. The 930E is the first production truck with a 320-ton payload and the first to adapt locomotive AC-drive technology to the haul truck industry. Built in Peoria, Illinois, it has a gross vehicle weight of over 1 million pounds.

BILL BONTEMPS
KOMATSU MINING SYSTEMS
VERNON HILLS, IL

A PM Collection

I have been a longtime follower of your great magazine. In 1947, I got my first subscription as a Christmas gift from my wife. I've been through good and bad times since then, including times when I couldn't afford a subscription. But I managed to buy every issue and store them all. I always intended to read them again, but haven't found the time.

I'm writing to find out if any of your readers would be interested in my collection. I don't want to sell them to a used-book store. This is history, not something to be split up and passed around.

DEAN G. TARBUTTON
3326 E. INDEPENDENCE
SPRINGFIELD, MO 65804

If you are interested in acquiring Mr. Tarbutton's collection, please contact him at the address above. —Ed.

Makeover Madness

I'm pleased that you're going to do more old car restorations and makeovers. What a great idea.

AL ALWIN
VIA INTERNET

Your car makeover article was excellent. Millions of older-vehicle owners (including myself) are with you. Those suffering from '98 sticker shock will probably concur.

JOE REDDY
CASSOPOLIS, MI

The makeover series is exciting, but your article did not mention how much it cost. Before you start a project you need at least an estimate of the cost involved.

RICHARD W. GATES
OLEAN, NY

Our cost is actually irrelevant. We didn't intend for the makeovers to be literal articles that would be followed step-by-step by readers. We meant them to show what we did as one approach to a makeover. We hope they will generate ideas as to what you might do with your own old car. —Ed.

Letters are subject to editing for length, style and format.

Advertisement

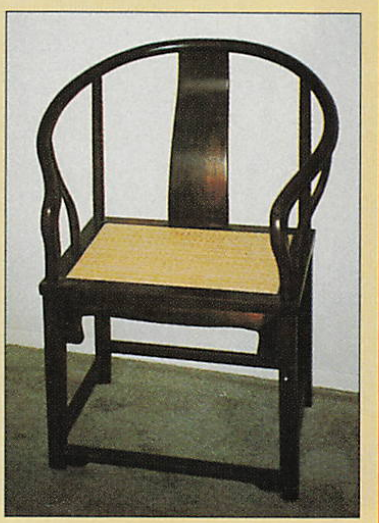
STANLEY

Reader Project Of The Month

My father wrote the following letter to POPULAR MECHANICS, but he did not get to send it. He passed away this January. He made beautiful furniture for his wife and children (all seven of us). We are proud of his woodworking skills.

I forwarded the letter to you because I would like to share with you all the work he put into this chair and your part in creating this fine piece of furniture.

MARTHA ARNETT



I am sending you a picture of a chair I made from plans I found in the January 1993 issue. The chair is called the Chinese Puzzle and is made of beech and red gum from a 1900 tobacco factory. I bought the seat, and the stain was a mixture I made up. JOHN ISBELL
GREENVILLE, KY

If your project is chosen as Reader Project Of The Month, you will receive a Stanley Home Improvement Kit, complete with hand and decorating tools, and an electric stapler/nailer, valued at more than $200. For your project to be considered, please send a clear, color photo and brief description to: Reader Project Of The Month, Popular Mechanics, 224 W. 57th St., New York, NY 10019.

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90 Years Ago: May 1908

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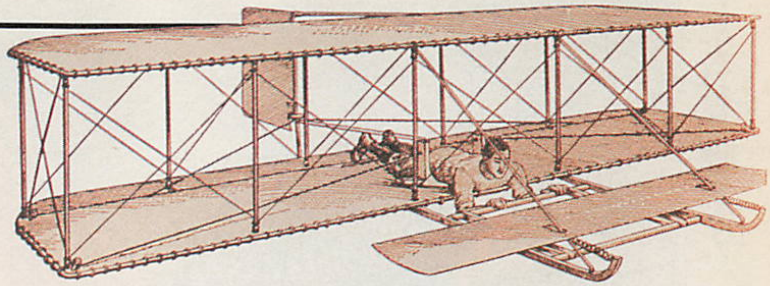
The Troubles of the Trouble Hunters
Target Practice in Our Navy
Great Record Run of New U. S. Cruiser
Largest Steam Engine in the World
The Making of a London Fireman

Higher Ground

After Galveston, Texas, was brought low by a tidal wave, the plan to prevent such calamities in the future was to raise the entire city 15 ft. First, houses, churches and business establishments were lifted up on stilts. Then huge pipes pumped a combination of sand and water into the streets. The water ran back into the bay, and the sand, rising inch by inch, crept up around the stilts until the buildings were once again on a solid foundation.



Wright Stuff?

When Wilbur and Orville made history at Kitty Hawk, they mounted an internal-combustion engine to their contraption for power. But who knows what those crafty bicycle mechanics had in mind when they sold a stripped version of their plane (no motor) to a buyer in England? This drawing, made from English patent papers, calls for the motion of the wings that are supposed to keep this machine airborne to be supplied by the hand and foot power of the pilot. Details on the actual operation of this plane are sketchy, but it was certainly labor intensive.

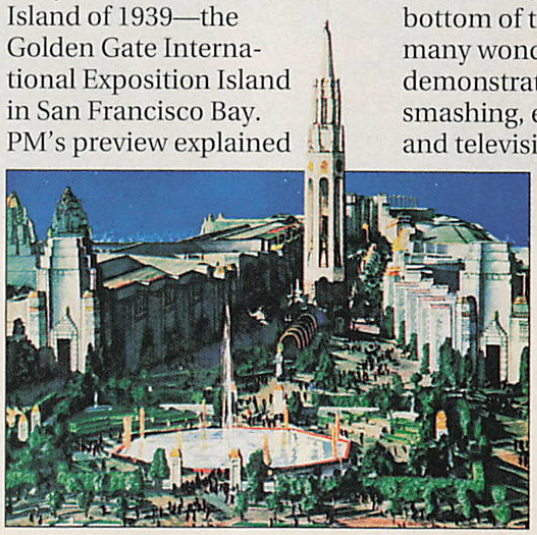
60 Years Ago: May 1938

Traffic Balloon

When traffic engineers in Milwaukee, Wisconsin, needed an eye in the sky to study intersections, they used a captive 12-ft.-dia., hydrogen-filled Goodyear balloon from which they suspended a 5 × 7-view camera equipped with an electric solenoid shutter release. Shots taken from a height of 300 ft. provided the flat photographic-scale layouts of intersections that were needed to gather data and spot potential hazards to motorists—and offer quick solutions to traffic tangles.

Bay Watch

They called it the Treasure Island of 1939—the Golden Gate International Exposition Island in San Francisco Bay. PM's preview explained how the 400-acre tract of land would be raised from the bottom of the sea. The fair's many wonders would include demonstrations of atom smashing, electronic music and television. A $20 million art exhibit would be displayed, probably for the first time, under perfect lighting. Exhibits would be housed in 27 buildings—all to be razed at the fair's completion to make way for an airport.



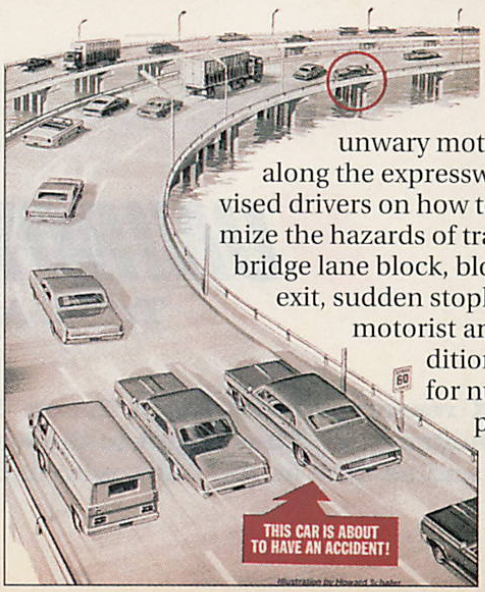
30 Years Ago: May 1968

How to Protect Yourself Against Highway Booby Traps
POPULAR MECHANICS
BUILD A VW-POWERED PLANE FOR $600
EARLY PREVIEW:
CAMPING '68
SPECIAL 32 PAGE SECTION

Flying Volkswagen

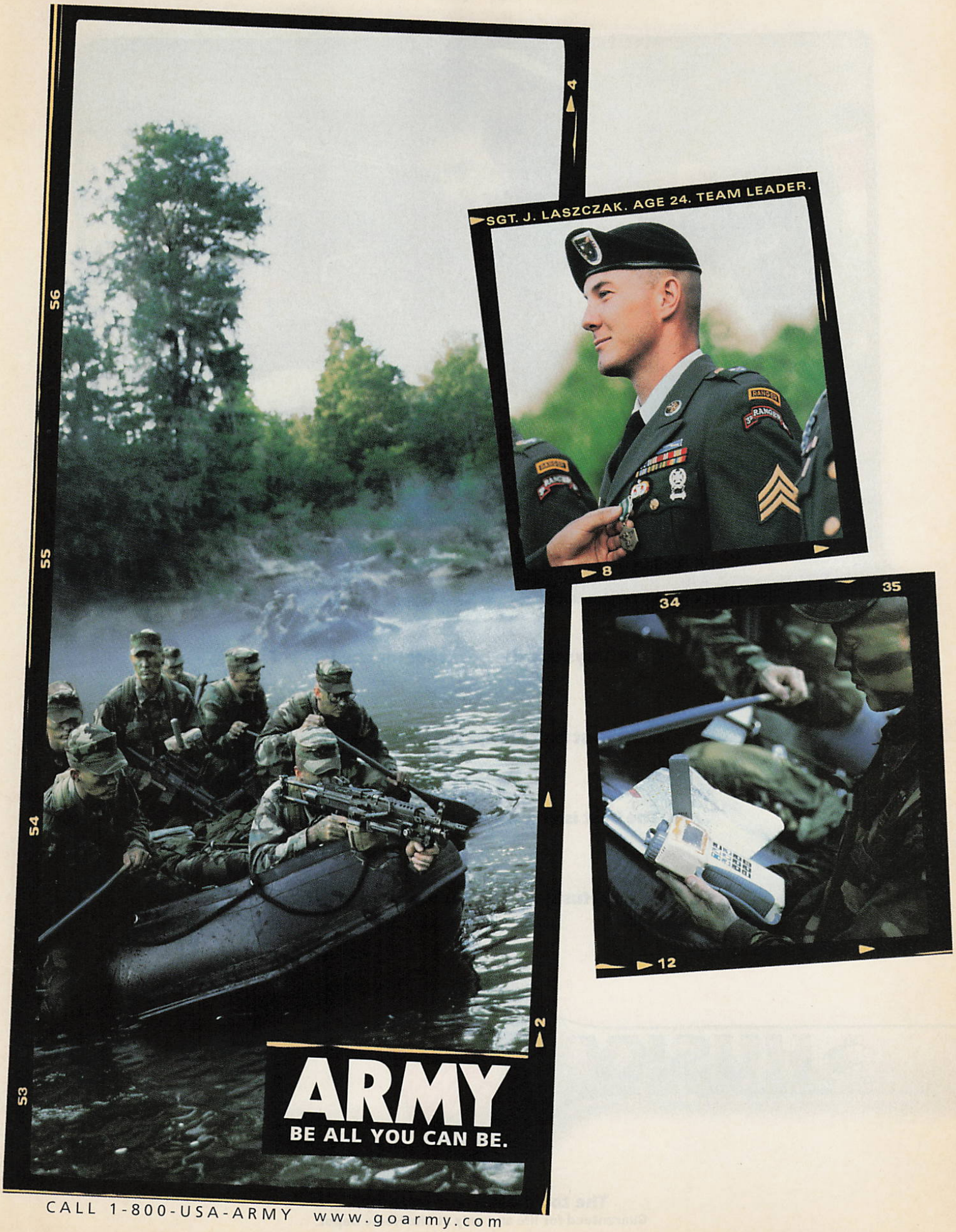
While the venerable VW Bug was not known for flying over the tarmac, its engine, albeit in used form, powered a homebuilt plane that could be put together for less than $600. The all-metal, open-cockpit, single-place Jeanie's Teenie was fabricated with ordinary rivets. It weighed 285 pounds, had a wingspan of 18 ft. and could hit 85 mph in the air. The prototype was flown by PM's aviation editor, who got quite a thrill when he experienced a throttle problem.

Deathtraps



Poor highway engineering translated into deathtraps for unwary motorists hammering along the expressway at 70 mph. PM advised drivers on how to recognize and minimize the hazards of traps such as the blind-bridge lane block, blocked exit, corkscrew exit, sudden stoplight, wrong-way motorist and stupid signs—conditions that had accounted for numerous fatalities. The piece offered effective evasive-action strategies to prevent tragedy in case you fell victim to one of these engineering blunders. PM

YOU'LL BE THE ONE OTHERS LOOK TO. YOU WILL BE A LEADER.



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[Hank's Helpful Hints]

1. Always use the best tool for the job.

2. The best isn't always the most expensive.

3. The best isn't always the most well-known.

4. Buy Husky and forget the other rules.

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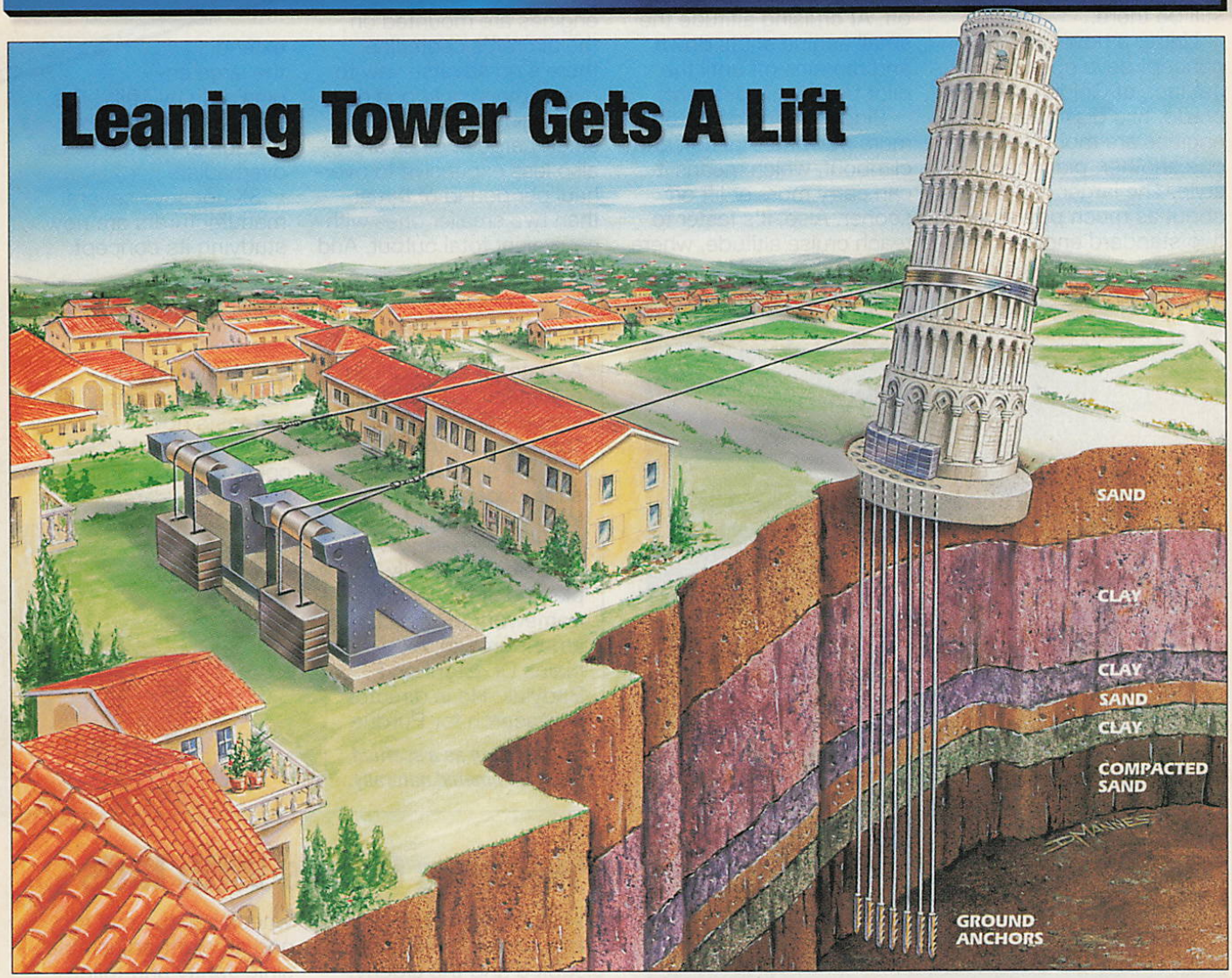
Leaning Tower Gets A Lift



While an international effort is under way to save Pisa, some residents in nearby Livorno would like to see gravity take its toll. They say the tilting tower steals tourists from their town.

After seven years of bureaucratic wrangling, engineers have finally begun straightening the Leaning Tower of Pisa in Italy.

Completed in 1350, the world-famous bell tower soon began settling on unstable subsoil. Fearing that after tilting 17 ft. off perpendicular it would finally topple, safety officials closed it to the public in 1990.

To save the 187-ft. marble tower, soil gradually will be removed from beneath the high side to balance natural settlement, says Michele Jamiolkowski, of the tower protection commission.

Before work begins, a pair of 3-in.-dia. plastic-coated steel cables will be connected 65 ft. up the tower. They will hold the structure if it suddenly shifts. Should soil continue to subside, a set of 165-ft.-long steel cables connected to ground anchors would be installed to prevent further movement by pinning the foundation in place.

When the job is done, in 1999, the tilt will have been reduced by about one half of a degree. "It is enough to save the tower but not be visible to the tourists," says Jamiolkowski.

Editor/Writer: Jim Wilson
Reporters: Stefano Coledan, Chris Dean, Brad Dunn, Stephen Farrand, Mike Fillon, William Garvey, Kathleen Gleaves, Robert Reichenbach

May Highlights

Piggyback Jets Share The Load— Under/over engines for safer flights.

■ **College Students Hit The Disc—**Multimedia CD-ROM obsoletes chemistry textbook.

■ **Light Cleans Grimy Monuments—**Fiberoptic-guided laser gives stone a gentle scrub.

ILLUSTRATION BY DON MANNES; PAUL YOULL PHOTO (GLOBE)

Piggyback Jet Engine

If the twinjet you board in the future seems to be missing half its engines, don't worry. They'll both still be there.

Under a novel power concept developed by 3X Jet Inc., of Golden, Colorado, two dissimilar-size engines are mounted atop one another, piggyback style. The larger engine has about as much power as two standard engines; the smaller equals one standard engine.

While taxiing, only the smaller engine runs. The big engine fires up for takeoff. At cruising altitude the small engine shuts down and remains off until the pilot begins his descent.

Piggybacking offers 50% more power for takeoff and climbout, which means it can carry more or lift off sooner. Also, it's faster to reach cruise altitude, where fuel economy is greatest. Because the engines are mounted on the aircraft's centerline, there's no adverse yaw to overcome should one of the engines fail, so it's safer. Large engines are also less expensive to overhaul per pound of thrust than two smaller ones with equivalent total output. And simply keeping the large engine off during taxi can extend the large engine's life by 10%. The small engine can go a decade or more between overhauls.

3X Jet says several manufacturers are now studying its concept.

ILLUSTRATION BY ED VALIGURSKY

Prospector Finds Water

Scientists reviewing data from NASA's *Lunar Prospector* believe there is water on the Moon.

Prospector's 653-pound robot laboratory began orbiting 60 miles above the Moon nine days after its launch aboard a Lockheed Martin solid-fuel Athena-2 rocket on Jan. 6 (below). The finding confirms data from the military's 1994 *Clementine* probe, which caused some scientists to speculate that soils in the polar regions might contain small amounts of water, as ice crystals. The existence of water on the moon could be a giant step for future space exploration, by improving the chances of building a lunar base, says Alan Binder, *Prospector*'s chief scientist.

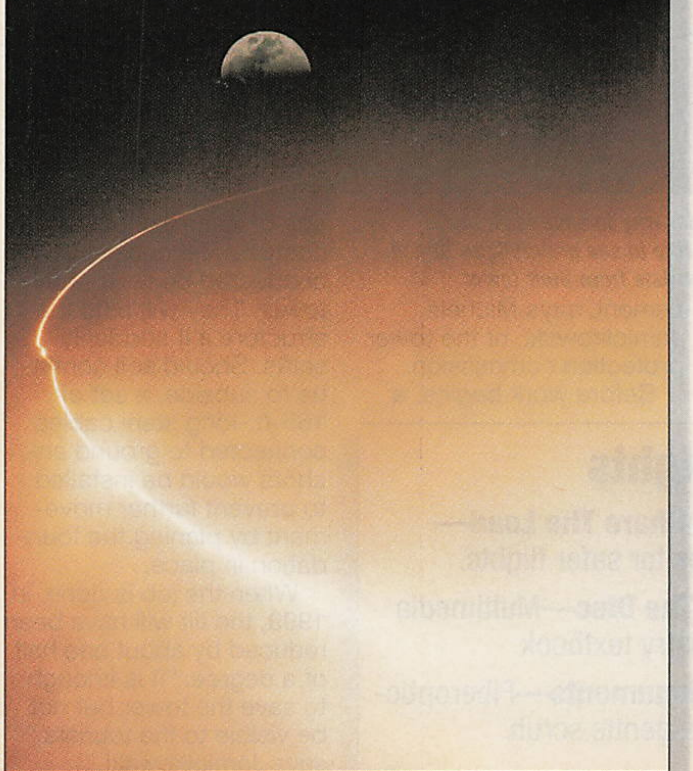


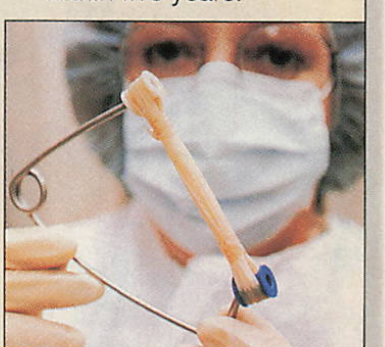
PHOTO BY NASA

Pig Guts For Damaged Knees

A material derived from pig intestines may help speed the healing of "blown-out" knees.

SIS—small-intestinal submucosa—is made from what essentially is sausage casing. After being surgically implanted, it serves as a framework for new ligament growth, explains Dr. Stephen F. Badylak. He is director of research for Purdue University in West Lafayette, Indiana.

If tests now under way prove successful, SIS could be in general use within five years.



After serving as a scaffold, SIS is eliminated naturally.

PHOTO BY PURDUE UNIVERSITY/KEVIN EVEREST

Plumbing Grows With Kids

To help make bathrooms easier to use for kids, the disabled and the elderly, Design Continuum Inc., of West Newton, Massachusetts, has created a set of adjustable fixtures.

Its Metaform Personal Hygiene System consists of a bathing area with a barrier-free shower for wheelchairs, a soft tub, and a height-adjustable sink, vanity and toilet.

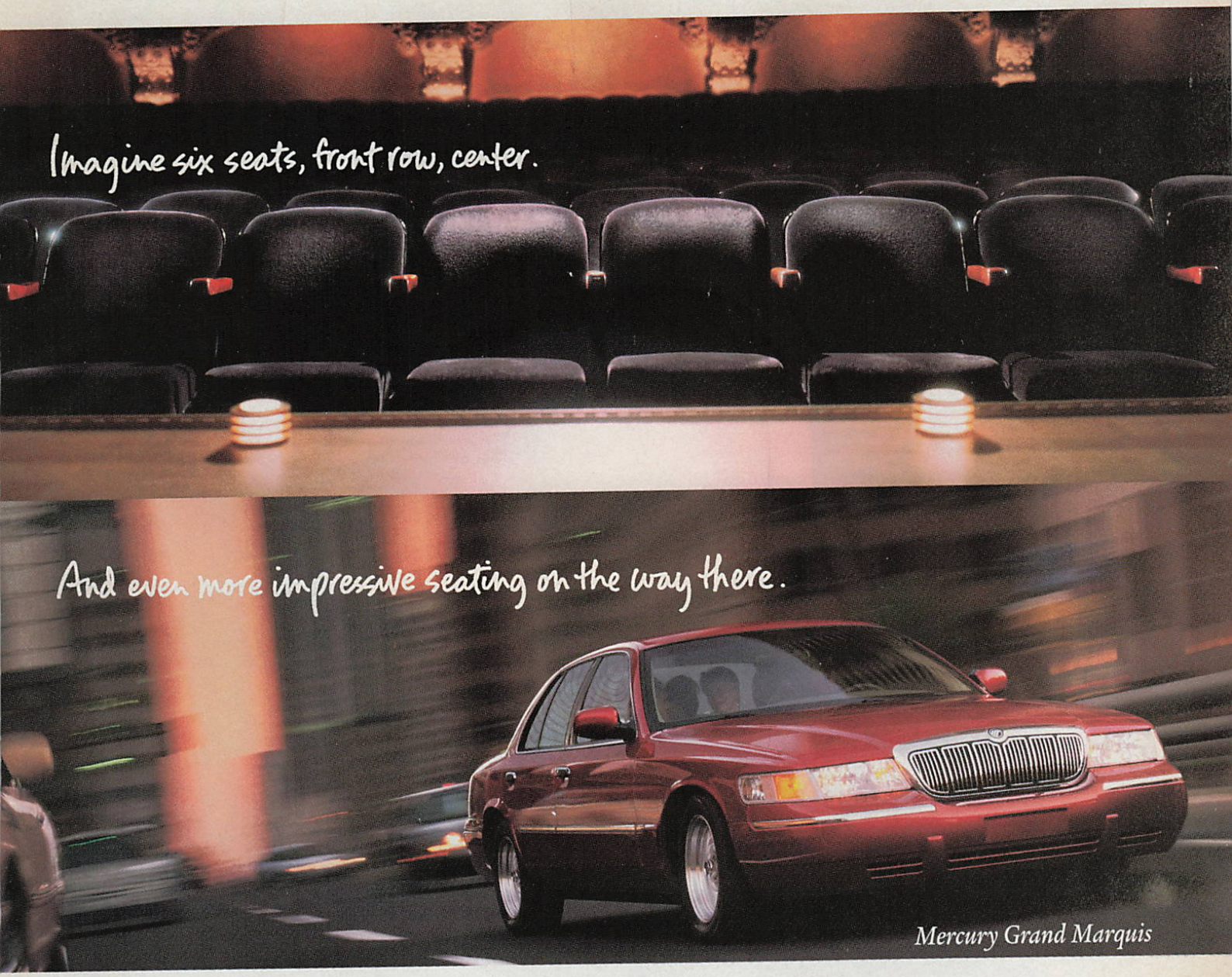
Gianfranco Zaccai, Continuum's president and lead designer, says he was inspired by watching the difficulty that his elderly father and 3-year-old daughter had using conventional fixtures.

Continuum will show off its prototype at the "Unlimited By Design" exhibit at the Cooper-Hewitt National Design Museum, in New York City.

The sink, shown here at a comfortable kid-height, adjusts from 24 to 42 in.

PHOTO BY DESIGN CONTINUUM INC.

(More Technology Watch on page 23)

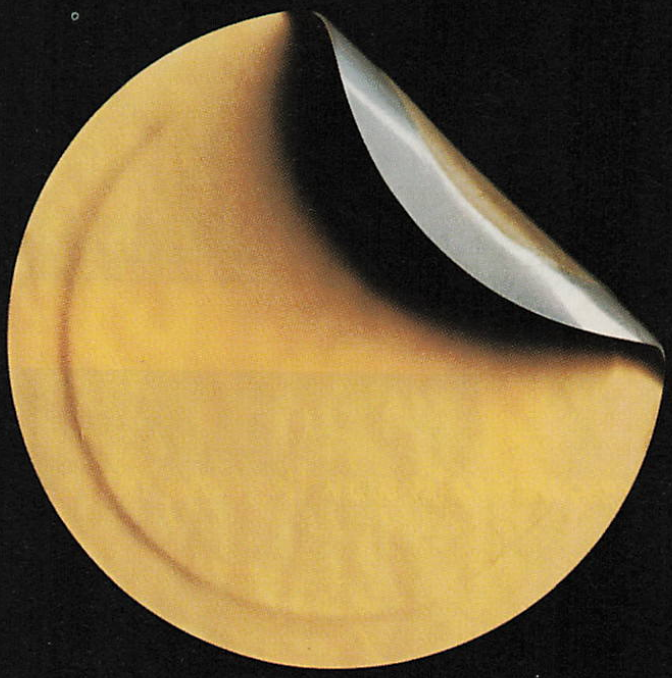


Imagine yourself in a Mercury

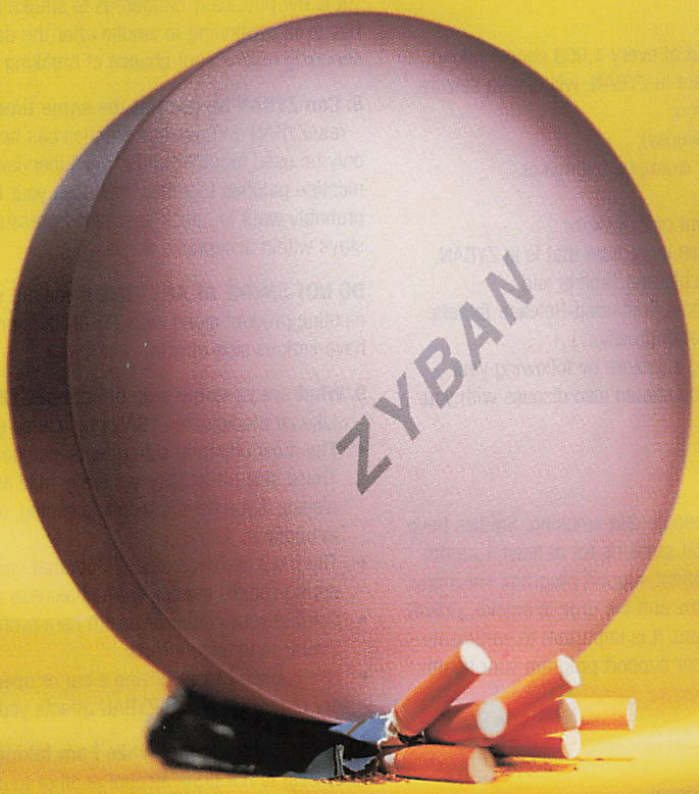
At Mercury, we believe you should enjoy yourself on the way to enjoying yourself. That's why we've created cars like the new Grand Marquis with the PrecisionTrac™ suspension system to give you improved handling and a smoother ride. We also made it incredibly luxurious to make sure your guests enjoy the journey. Call 1 800 446-8888 or visit our web site at www.mercuryvehicles.com.

If you're ready to quit smoking

OFF WITH THE PATCH...



ON TO THE NICOTINE-FREE PILL



ZYBAN beat the #1 prescription patch[1]

ZYBAN has been proven more effective than a nicotine patch

In a medical study using patient support materials and drug therapy, ZYBAN helped more smokers quit for 4 weeks than Habitrol® (nicotine transdermal system),* a nicotine patch. And unlike the patch and gum, ZYBAN replaces cigarettes with nicotine-free medicine.

You can break free from smoking

If you've tried to quit before and are still smoking, ask your health care professional about nicotine-free ZYBAN. It's a pill. Prescription medicine that can help reduce your urge to smoke and make quitting bearable.

What you need to know about ZYBAN

The most common side effects with ZYBAN include dry mouth and difficulty sleeping. Although uncommon, there is a risk of seizure associated with ZYBAN. (See "Important Warning" section in Information for the Patient on following page.) So it is important to talk to your health care professional to see whether ZYBAN is right for you. You should not take ZYBAN if you have a seizure disorder; are already taking WELLBUTRIN®, WELLBUTRIN SR®, or any other medicines that contain bupropion HCl; have or have had an eating disorder; or are currently taking or have recently taken a monoamine oxidase (MAO) inhibitor. It is important to let your health care professional know about any other prescription or over-the-counter medications you are taking. ZYBAN is not recommended for women who are pregnant or breast-feeding.

SEE YOUR HEALTH CARE PROFESSIONAL ABOUT ZYBAN

ZYBAN and the ZYBAN Advantage Plan™, a free counseling and personalized support program, are part of an overall plan recommended by your health care professional to help you quit smoking.

For more information, call **1-888-959-STOP (7867) ext. 49** or visit our Web site at www.zyban.com

BREAK FREE FROM NICOTINE
BREAK FREE FROM SMOKING

NICOTINE-FREE
ZYBAN™
bupropion HCl sustained-release tablets 150 mg

Reference: 1. Scott-Levin Source Prescription Audit (SPA) 9/97.

* Habitrol is a registered trademark of Ciba-Geigy Corporation.

Please consult Information for the Patient on the following page.

Information for the Patient

ZYBAN™ (bupropion hydrochloride) Sustained-Release Tablets

Please read this information before you start taking ZYBAN. Also read this leaflet each time you renew your prescription, in case anything has changed. This information is not intended to take the place of discussions between you and your doctor. You and your doctor should discuss ZYBAN as part of your plan to stop smoking. Your doctor has prescribed ZYBAN for your use only. Do not let anyone else use your ZYBAN.

IMPORTANT WARNING:

There is a chance that approximately 1 out of every 1,000 people taking bupropion hydrochloride, the active ingredient in ZYBAN, will have a seizure. The chance of this happening increases if you:

- have a seizure disorder (for example, epilepsy);
- have or have had an eating disorder (for example, bulimia or anorexia nervosa);
- take more than the recommended amount of ZYBAN; or
- take other medicines with the same active ingredient that is in ZYBAN, such as WELLBUTRIN® (bupropion hydrochloride) Tablets and WELLBUTRIN SR® (bupropion hydrochloride) Sustained-Release Tablets. (Both of these medicines are used to treat depression.)

You can reduce the chance of experiencing a seizure by following your doctor's directions on how to take ZYBAN. You should also discuss with your doctor whether ZYBAN is right for you.

1. What is ZYBAN?

ZYBAN is a prescription medicine to help people quit smoking. Studies have shown that more than one third of people quit smoking for at least 1 month while taking ZYBAN and participating in a patient support program. For many patients, ZYBAN reduces withdrawal symptoms and the urge to smoke. ZYBAN should be used with a patient support program. It is important to participate in the behavioral program, counseling, or other support program your health care professional recommends.

2. Who should not take ZYBAN?

You should not take ZYBAN if you:

- have a seizure disorder (for example, epilepsy).
- are already taking WELLBUTRIN, WELLBUTRIN SR, or any other medicines that contain bupropion hydrochloride.
- have or have had an eating disorder (for example, bulimia or anorexia nervosa).
- are currently taking or have recently taken a monoamine oxidase inhibitor (MAOI).
- are allergic to bupropion.

3. Are there special concerns for women?

ZYBAN is not recommended for women who are pregnant or breast-feeding. Women should notify their doctor if they become pregnant or intend to become pregnant while taking ZYBAN.

4. How should I take ZYBAN?

- You should take ZYBAN as directed by your doctor. The usual recommended dosing is to take one 150-mg tablet in the morning for the first 3 days. On the fourth day, begin taking one 150-mg tablet in the morning and one 150-mg tablet in the early evening. Doses should be taken at least 8 hours apart.
- **Never take an "extra" dose of ZYBAN.** If you forget to take a dose, do not take an extra tablet to "catch up" for the dose you forgot. Wait and take your next tablet at the regular time. Do not take more tablets than your doctor prescribed. This is important so you do not increase your chance of having a seizure.
- It is important to swallow ZYBAN Tablets whole. Do not chew, divide, or crush tablets.

5. How long should I take ZYBAN?

Most people should take ZYBAN for 7 to 12 weeks. Follow your doctor's instructions.

6. When should I stop smoking?

It takes about 1 week for ZYBAN™ (bupropion hydrochloride) Sustained-Release Tablets to reach the right levels in your body to be effective. So, to maximize your chance of quitting, you should not stop smoking until you have been taking ZYBAN for 1 week. You should set a date to stop smoking during the second week you're taking ZYBAN.

7. Can I smoke while taking ZYBAN?

It is not physically dangerous to smoke and use ZYBAN at the same time. However, continuing to smoke after the date you set to stop smoking will seriously reduce your chance of breaking your smoking habit.

8. Can ZYBAN be used at the same time as nicotine patches?

Yes, ZYBAN and nicotine patches can be used at the same time but should only be used together under the supervision of your doctor. Using ZYBAN and nicotine patches together may raise your blood pressure. Your doctor will probably want to check your blood pressure regularly to make sure that it stays within acceptable levels.

DO NOT SMOKE AT ANY TIME if you are using a nicotine patch or any other nicotine product along with ZYBAN. It is possible to get too much nicotine and have serious side effects.

9. What are possible side effects of ZYBAN?

Like all medicines, ZYBAN may cause side effects.

- The most common side effects include dry mouth and difficulty sleeping. These side effects are generally mild and often disappear after a few weeks. If you have difficulty sleeping, avoid taking your medicine too close to bedtime.
- The most common side effects that caused people to stop taking ZYBAN during clinical studies were shakiness and skin rash.
- Contact your doctor or health care professional if you have a rash or other troublesome side effects.
- Use caution before driving a car or operating complex, hazardous machinery until you know if ZYBAN affects your ability to perform these tasks.

10. Can I drink alcohol while I am taking ZYBAN?

It is best to not drink alcohol at all or to drink very little while taking ZYBAN. If you drink a lot of alcohol and suddenly stop, you may increase your chance of having a seizure. Therefore, it is important to discuss your use of alcohol with your doctor before you begin taking ZYBAN.

11. Will ZYBAN affect other medicines I am taking?

ZYBAN may affect other medicines you're taking. It is important not to take medicines that may increase the chance for you to have a seizure. Therefore, you should make sure that your doctor knows about all medicines—prescription or over-the-counter—you are taking or plan to take.

12. Do ZYBAN Tablets have a characteristic odor?

ZYBAN Tablets may have a characteristic odor. If present, this odor is normal.

13. How should I store ZYBAN?

- Store ZYBAN at room temperature, out of direct sunlight.
- Keep ZYBAN in a tightly closed container.
- Keep ZYBAN out of the reach of children.

This summary provides important information about ZYBAN. This summary cannot replace the more detailed information that you need from your doctor. If you have any questions or concerns about either ZYBAN or smoking cessation, talk to your doctor or other health care professional.

GlaxoWellcome

Glaxo Wellcome Inc.
Research Triangle Park, NC 27709

U.S. Patent Nos. 5,427,798 and 5,358,970

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RL-425

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Printed in USA BUP305R0 January 1998

Chemistry Book On Disc

Few college courses are as daunting as freshman chemistry. Worse yet, most students don't know the best way to use the textbook, laments Claude Yoder, a chemistry professor at Franklin & Marshall College in Lancaster, Pennsylvania. "They read it as they would a novel, without a pencil and paper in hand to solve problems."

To make the subject more memorable, Yoder has coauthored *Interactive Chemistry*. Published as a CD-ROM, the multimedia text uses animation to lead students through problems.

Interactive Chemistry will debut in college bookstores in the fall.

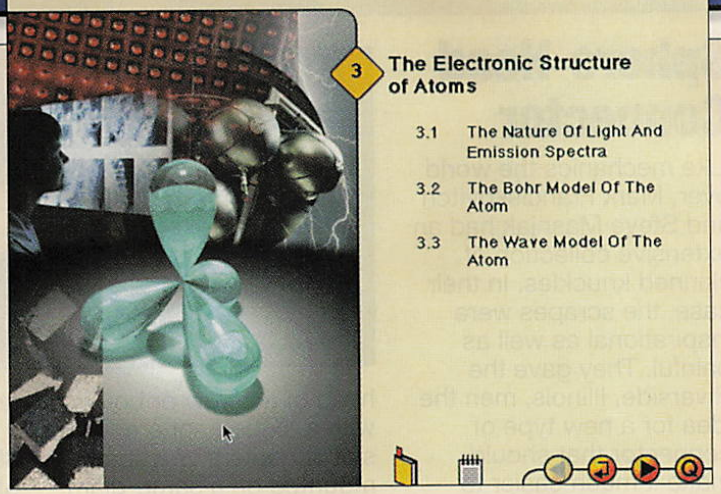

3
The Electronic Structure of Atoms
3.1 The Nature Of Light And Emission Spectra
3.2 The Bohr Model Of The Atom
3.3 The Wave Model Of The Atom

IMAGE BY 1996 MOSBY-YEAR BOOK/CLAUDE YODER

Unmanned Scouting Vehicle

PHOTO BY ROBOTIC SYSTEMS TECHNOLOGY

An automated vehicle could take over the dangerous job of scouting enemy positions.

The Army's Tank-Automotive and Armaments Command (TACOM) has given Robotic Systems Technology (RST), of Westminster, Maryland, $23 million to develop and demonstrate four roboscouts able to find enemy tanks. The 2500-pound vehicles will be able to safely travel along roads at 40 mph and cross-country at 20 mph. Once in a hostile area, intelligent vision systems would identify moving and stationary tanks, in day and night.

"Tactical robotic systems could provide a true force multiplier," says RST president Scott Myers.

Testing will conclude in 2002, after which TACOM will decide on whether robot scouts are fit for battle.

Sea-Friendly Ship Paint

Antifouling paints save energy by poisoning marine organisms—such as barnacles—that attach themselves to hulls, creating unwanted weight and drag.

The paints work by poisoning marine life. Unfortunately, the copper oxides that are their active ingredient can harm shellfish, algae and other beneficial marine life.

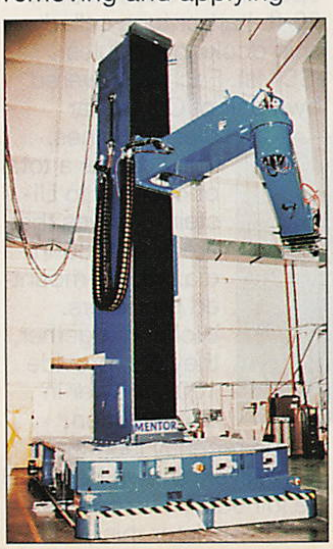
Monopol Paints Group, of Cursan, France, a specialist in industrial coatings, says it has found a safer way to keep hulls clean. Its Biomarine antifouling paint replaces troublesome metals and toxic products with a self-polishing acrylic resin that, the company claims, harmlessly repels marine organisms.

Monopol has begun selling its product in Europe and hopes to introduce it in the United States by 2000.

PHOTO BY FRENCH TECHNOLOGY PRESS OFFICE

Giant Robot Paints Planes

A giant mobile robot has begun performing one of the least favorite jobs in the aviation industry: removing and applying paint to aircraft.



Now in operation at Tinker Air Force Base near Oklahoma City, Oklahoma, the 35,000-pound robot uses a large, multiposition arm to get at all the hard-to-reach places around the airframe. On the first pass a high-pressure water jet "depaints" the plane, preparing its metal. Then it makes another pass to apply the new colors.

A big brother of this original unit will apply radar-energy-absorbing coatings to future F-22 air superiority fighters, saving thousands of hours of work and millions of dollars, compared to conventional methods.

Electric-powered feet provide an ultrastable platform.

PHOTO BY PRATT & WHITNEY

Smart Lenses For Near-Blind

PHOTO BY NORTH CAROLINA NEWS SERVICE

A new tool is available to help nearly blind patients whose vision cannot be corrected with glasses, eye surgery or laser treatment.

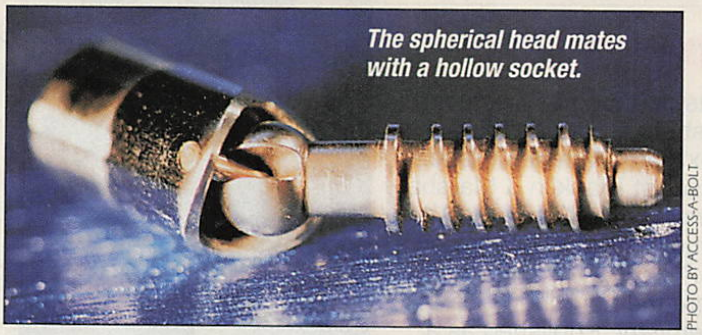
The VESTM AutoFocus Telescope, made by Ocutech of Research Triangle Park, North Carolina, uses a mechanism similar to those found on cameras, explains developer Henry Greene.

He estimates it could improve the lives of many of the estimated 4.8 million vision-impaired people in the United States.

Sphere-Head Connector

Like mechanics the world over, Mark Franciskovitch and Steve Masnjak had an extensive collection of skinned knuckles. In their case, the scrapes were inspirational as well as painful. They gave the Riverside, Illinois, men the idea for a new type of connector that should make it much easier to work in tight spaces.

Called an Access-A-Bolt, the connector replaces the normally flat head of a screw or bolt with a slotted sphere. This slot accepts a crossbar mounted on a same-diameter socket, as shown above. Sockets can be either built into a drive handle or attached to a standard socket wrench.



The spherical head mates with a hollow socket.

PHOTO BY ACCESS-A-BOLT

"The head will allow 360° access at a 50° angle off the axis of the bolt," Franciskovitch says. "If you can see or feel the bolt head, you can remove it." And, because of the greater depth provided by the spherical shape, he says the heads can't be stripped.

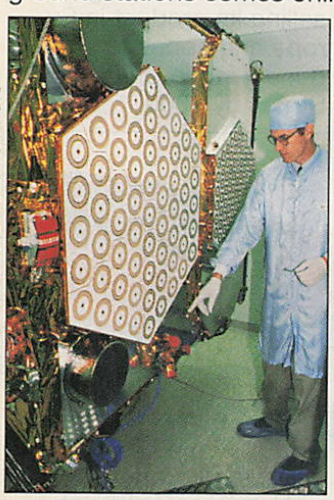
After experimenting with prototypes made from ball bearings welded to bolts, Franciskovitch built several finished pieces, including ratchet-type hose clamps. Production connectors would be made as a single piece, like ordinary bolts.

Franciskovitch says several automakers and connector manufacturers are evaluating prototypes. He and Masnjak have also formed a company to sell the connectors themselves.

First Globalstar Satellites Orbit

Globalstar has successfully launched the first four of the 48 low-Earth-orbiting satellites in its worldwide communication network, from Cape Canaveral, Florida.

When all are in orbit and an array of 60 ground stations comes online, people will be able to call around the world directly from cellular-sized handheld phones.



LORAL SPACE & COMMUNICATIONS LTD./DAVID BENTON PHOTO

After a set of launches this spring, operations will move to the Baikonur Cosmodrome in Kazakhstan. In July, the balance of the satellites will be launched a dozen at a time aboard Ukrainian-built Zenit II rockets.

If the launch timetable remains on track, commercial service will begin in 1999.

Technicians inspect one of the system's 48 satellites.

The Shape Of Tugs To Come

More than 12,000 ships a year dock at Port Everglades, Florida, which in some places is so tight that large ships pass within 200 ft. of each other.

PHOTO BY HALTER MARINE

To work in these conditions, Halter Marine, of Gulfport, Texas, has developed a new class of 90 × 50-ft. harbor tugs called ship docking modules (SDMs). Each is powered by a pair of Caterpillar diesel engines. They deliver a total of 4000 hp to Ulstein Z-drives that are fit with 86-in.-dia. nozzle-mounted propellers. Working together, they can provide 100% power in any direction.

The recently launched *New River*, shown here, will be joined by two companion SDMs later this year.

Compact Natural Gas Tank

ISS attaches to a car body like conventional gasoline tanks.

Energy gurus say natural gas beats petroleum-based fuels hands down. Supplies are vast and widely distributed. It doesn't need to be refined. And pipelines from wells to cities have existed for decades. What's more, it burns cleaner than gasoline or diesel fuel.

Despite these advantages, the fuel hasn't fired the imagination of car-buyers. And with good reason. To store enough of the gas requires a tank too big for most cars.

Researchers at The Johns Hopkins University Applied Physics Laboratory, in Laurel, Maryland, say their Integrated Storage System (ISS) solves the problem. Made of lightweight composites, it is capable of safely containing gas at 3600 psi. This makes it possible to store enough fuel for most people's travel needs. A demonstration car with ISS is scheduled to debut this fall.

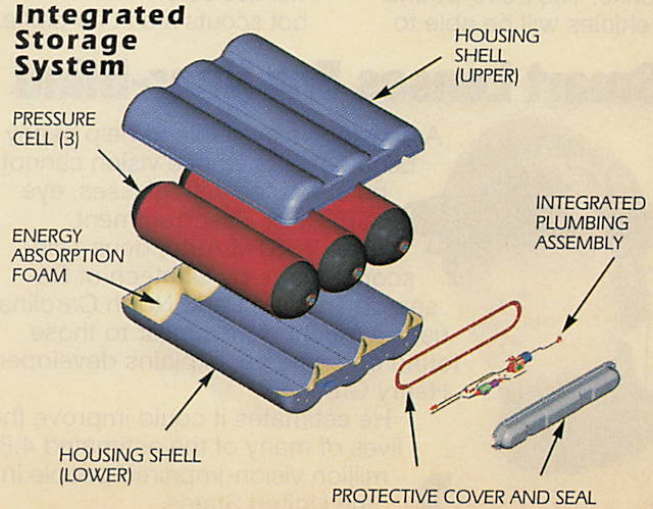


PHOTO AND ILLUSTRATION BY THE JOHNS HOPKINS UNIVERSITY

(More Technology Watch on page 26)

DON'T GET STUCK WITH A FLAT.

INTRODUCING GOODYEAR'S NEWEST RUN-FLAT TIRE.

New Goodyear Aquasteel Run-Flat can suffer a major puncture, lose all air pressure and still run up to 50 miles at 55 mph to safety.* But the technological news doesn't end there. Its aquachannels and ultra-tensile steel ply mean Aquasteel also delivers exceptional wet traction and handling. New Aquasteel Run-Flat. Serious technology. Freedom from worry. Only from Goodyear.

The Aquasteel sidewall is built to maintain its shape and driveability even after losing all air pressure.

NEW AQUASTEEL™ RUN FLAT™

- *Reinforced sidewalls allow Aquasteel to drive for miles, even with no air pressure.*
- *High-tensile steel ply takes on road hazards. And beats them.*
- *Dual aquachannels sweep water away for outstanding wet traction. Especially in braking.*
- *Computer design means extra-long lasting treadwear, responsive cornering and quiet, smooth ride.*
- *H-speed rated, road-hugging Eagle performance.*

Locations: 1-800-RUNFLAT Web site: www.goodyear.com

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SERIOUS TECHNOLOGY
FREEDOM FROM WORRY

Pressure monitoring system required. See owner's manual/limited warranty for details. *©1998, The Goodyear Tire & Rubber Company. All rights reserved.*

Blood Vessels Grown From Patients' Cells

Bioengineers have constructed an artificial blood vessel that is 20 times stronger than natural ones—and it's made entirely from human cells.

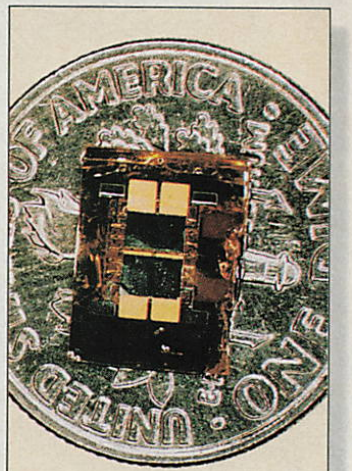
The replacement blood vessel, which contains no synthetic materials, can be used for patients who need coronary bypass surgery. "The blood vessel displays the function, look and feel of real tissue," says Nicolas L'Heureux, a researcher at the University of California, San Diego School of Engineering, and a leader of the project.

The artificial vessel can handle about 20 times normal human blood pressure.

PHOTO BY UCSD

Cells for the artificial blood vessel are extracted from vessels in the patient's leg and then grown in a bioreactor that simulates human body conditions. "We mimic the body's environment, and transform skin cells into blood vessel cells," says L'Heureux.

A blood vessel grown from a patient's own cells promises several advantages. With no chance of an immune response, no scar tissue will build around the artificial vessel. Consequently, doctors can make smaller, more precise matches with the natural blood vessel and improve blood flow patterns.



Mightiest Microrelay

Achieving a record switching power of up to 1.2 amps, researchers have designed the newest, strongest microrelay.

Developed by the Georgia Institute of Technology, in Atlanta, these magnetically actuated microrelays, shown above, can be batch-produced like computer chips and offered at cheaper prices than conventional electromechanical relays.

IMAGE BY GEORGIA TECH/ALLEN/TAYLOR

Smart Cards In, Cash Out

They may be considered unlikely pioneers of the digital age, but Ugandans have taken the world's first giant step toward a cashless society.

In a move to bolster economic growth by curbing its extremely high robbery rate, Uganda is turning from currency to Smart Money—a system of cards that stores funds digitally.

Smart Cards, which are produced by Productivity Enhancement Products, of Laguna Hills, California, work like automated teller machine cards—they are personalized and protected by the user's photo and a personal identification number. But the cards function like cash, with their value stored on a small computer chip embedded in the card. Merchants use PC-based cash registers to deduct payments.

The Ugandan government has thrown its support behind the card by requiring its agencies to use Smart Cards to buy fuel and collect taxes.

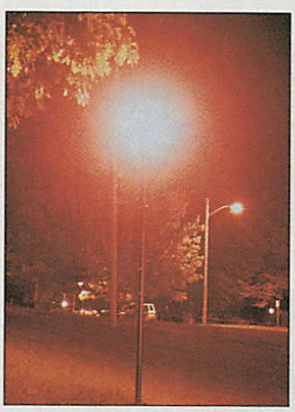
If its success continues, the Smart Card system may be used for driving licenses, military identification and employee payment.

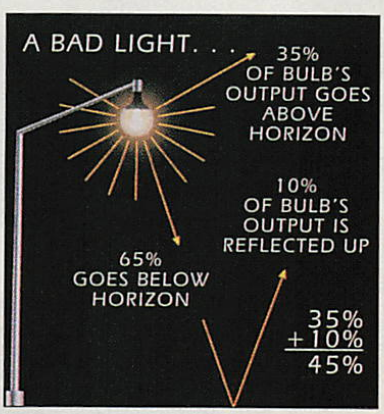
New Lights For Stargazers

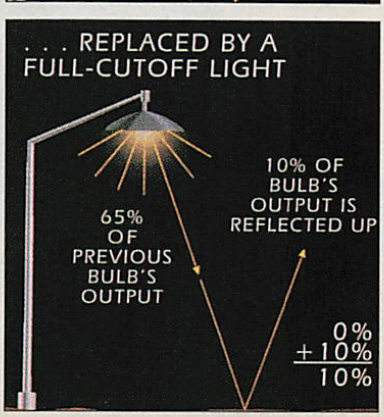
An astronomy course at Wesleyan University, in Middleton, Wisconsin, is shedding light on an important but virtually unrecognized problem: light pollution. "Few of today's students have ever seen the Milky Way," says instructor Arthur Upgren.

The night sky above a city can be up to 25 times brighter than natural conditions. When streetlamps are shielded (right), fewer of the light-reflecting aerosols in the atmosphere are illuminated, and more stars shine through.

There are benefits for those who prefer to stay indoors, too. The improved lamp designs substantially cut energy costs.







PHOTOS AND ILLUSTRATIONS BY WESLEYAN UNIVERSITY/UPGREN

Molecular Personality

Apparently, molecules have personalities, too.

In a series of experiments to understand the physical behavior of single molecules, Stanford University researchers have discovered that identical polymers subjected to identical forces will respond in unpredictable ways.

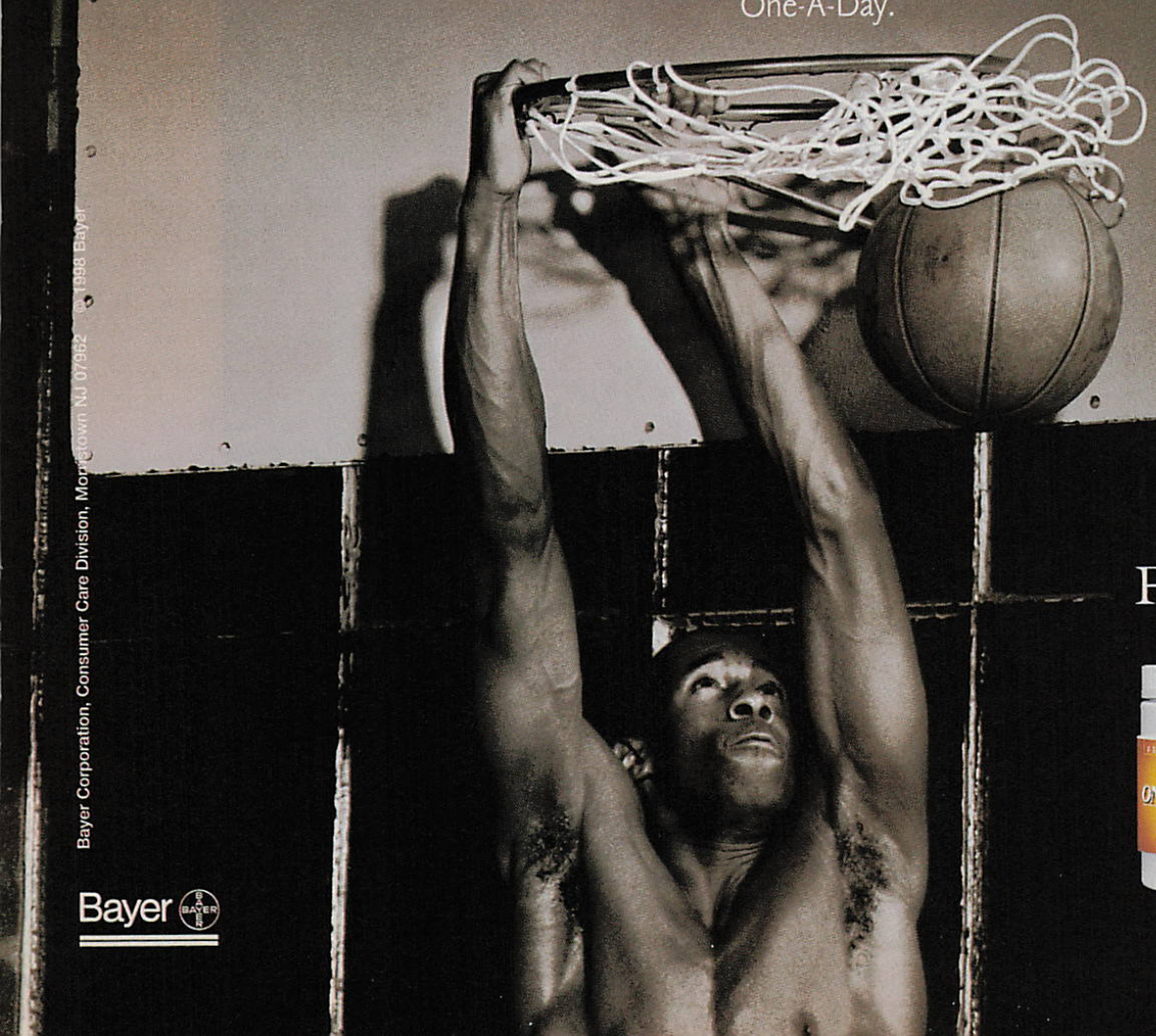
"This is due to tiny differences resulting from thermal fluctuations in their starting conditions," says Steven Chu, a Stanford professor of physics.

Still, though, molecules are a bit more predictable than humans. Chu says their behavior can be explained using linear equations.

(More Technology Watch on page 28)

Norman needs a worthy opponent. More vitamin E. And some time to just hang.

What makes Norman different? Well, for starters, he can hang off a regulation height basket, no problem. He's never once shied away from a pick-up game. And, to be the best Norman he can, he needs the right combination of nutrients. That's why we make a One-A-Day® just for men. It's got all the manly stuff men need. Like more vitamin E (more than any other leading multivitamin, in fact). Plus extra B vitamins. And it doesn't have what men don't need, like iron. So to feel your best, start by taking the one vitamin made for how a man's made. Take your One-A-Day.



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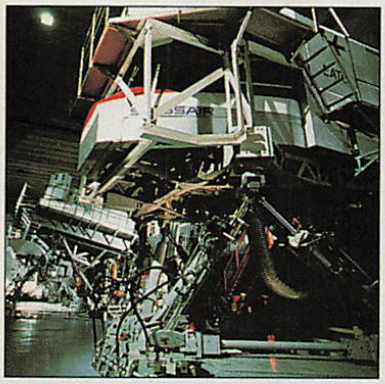
Screaming For An Explanation



"Thrill Ride" shows the history of scream machines.

PHOTOS BY SONY PICTURES CLASSICS

Now even the merry-go-round set can enjoy the excitement of the world's biggest and scariest roller coasters, from the comfort of a movie seat.

The film, "Thrill Ride, The Science of Fun," takes viewers along as it looks at rides from 18th-century Russian ice slides to computer-controlled roller coasters.

The 40-minute film shoots viewers into space on the Las Vegas "Big Shot," spins them upside down on the "Kumba" at Busch Gardens in Florida, and sends them through time on Universal Studio's "Back to the Future" motion simulator.

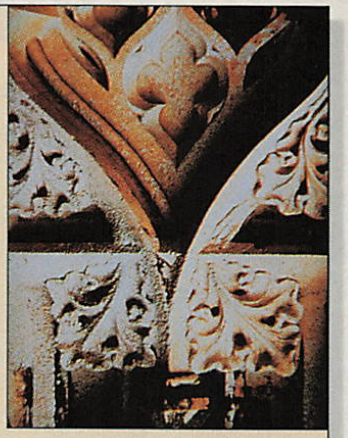
"Thrill Ride" will appear at IMAX theaters this year.

Cleaning Is A Real Blast

A scrub brush that works with laser light instead of soapy water is changing the way preservationists clean stained masonry.

Because stains are darker than clean areas, they absorb more energy when exposed to high-intensity light.

A train of laser bursts creates sufficient heating within the stained area to set up mini shock waves. These in turn flake the discoloration into dust.



A camera-like device focuses the laser light on the stain that needs to be removed.

Laser cleaning technology has been known for 20 years. The Lama System, shown here at a site in Tours, France, makes the technique practical by using a 200-ft. fiberoptic cable to get to hard-to-reach places—even cleaning behind the ears of cathedral gargoyles.

PHOTOS BY FRENCH TECHNOLOGY PRESS OFFICE

Gives traditional luxury cars a swift kick in the ascot.

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Juries May Misread DNA Data

Scientists want journalists and jurors to be more careful with DNA.

The perception that DNA is a proof-positive way to identify suspects doesn't hold true for all types of samples, researchers cautioned at the annual meeting of the American Association for the Advancement of Science, in Philadelphia. DNA from hair—the evidence most often obtained at crime scenes—is less reliable than that from blood and other body fluids.

How attorneys phrase DNA reports can also sway opinions, said Jonathan Koehler, of the University of Texas. In an experiment, one mock jury was told there was a 0.1% chance of a suspect's DNA matching that found at the crime scene. The second was told there was a 1 in 1000 chance of a match.

Although the odds were identical, the first jury saw a link, while the second felt there was little connection.

PHOTO BY BRUCE COLEMAN/JANE BURTON

Powerful Gene Switch

Conventional scientific wisdom holds that it took a complex series of genetic changes—and a long time—for aquatic creatures to adapt to land.

Apparently, no one told *Mexican axoloti*, a salamander that normally develops underwater and lives on land as an adult. Scientists at the University of California at Davis, who studied the DNA of a mutant variety that never leaves the water, discovered a single gene triggers the sea-to-land transformation.

The finding could cause scientists to reevaluate some basics about the speed at which species evolve.

A Really Old Melting Pot

DNA tests suggest America was peopled by as many as five different civilizations.

The results confirm archeological findings that suggest the first of these peoples arrived as early as 35,000 years ago. The evidence includes the discovery of a 12,500-year-old hunting camp in Monte Verde, Chile. And 9000-year-old remains with Caucasian features were found in the Pacific Northwest.

The DNA data—presented at the annual meeting of the American Association for the Advancement of Science, in Philadelphia—challenges the accepted theory that the Americas were initially populated by a single people who crossed a land bridge that linked Siberia and Alaska about 11,500 years ago.

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Technology Watch

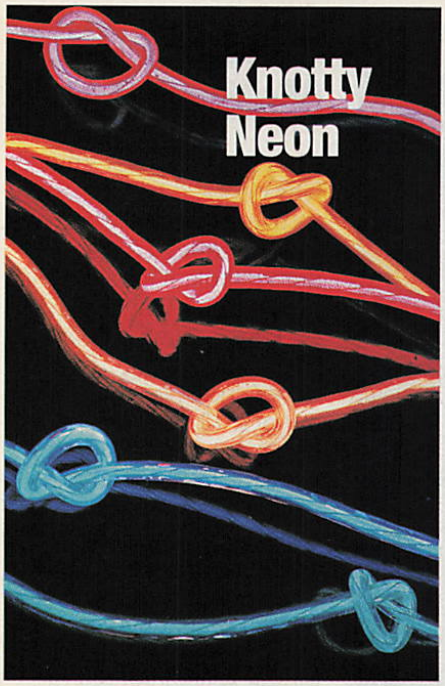

PHOTO BY LIVE WIRE ENTERPRISES

A new lighting technology solves the knotty problem of making tight bends in decorative lighting.

Called Live Wire, it consists of a thin, phosphor-coated copper cable that emits one of 10 colors when energized.

"Unlike fiberoptics, it yields an even output of light and color throughout its length," says Harold Feldman, spokesman for New York-based Live Wire Enterprises.

Encased in plastic, the cable is flexible enough to be tied in knots. Even more appealing is its low power consumption. The same power required to run a single 100-watt bulb can illuminate 1000 ft. of cable. Smaller sections, for decorating hats for example, can be battery-powered.

Robot Stands In For Sick Kids

Sometimes, kids are too sick to attend school. "Pebbles," waving at you on the left, uses "telepresence" technology to bring these youngsters into the classroom.

Pebbles contains video-conferencing equipment built by Telebotics, in Toronto. The robot also has kid-friendly touches: a swiveling monitor for better eye contact and a hand that waves to get attention.

PHOTO BY RYERSON POLYTECHNIC UNIVERSITY

Name That Cow

To keep milk from sick cows out of the food supply, Boumatic, of Madison, Wisconsin, has developed a medical alert tag.

A scanner reads the tag, then checks the cow's medical history. If it is sick, an alarm sounds and the cow milk is dumped.

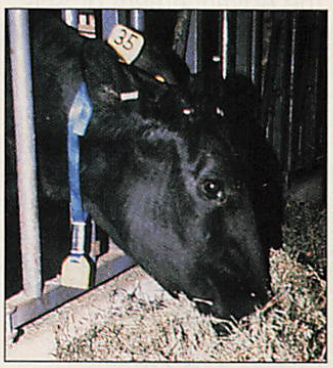

PHOTO BY BOUMATIC DEC

GPC

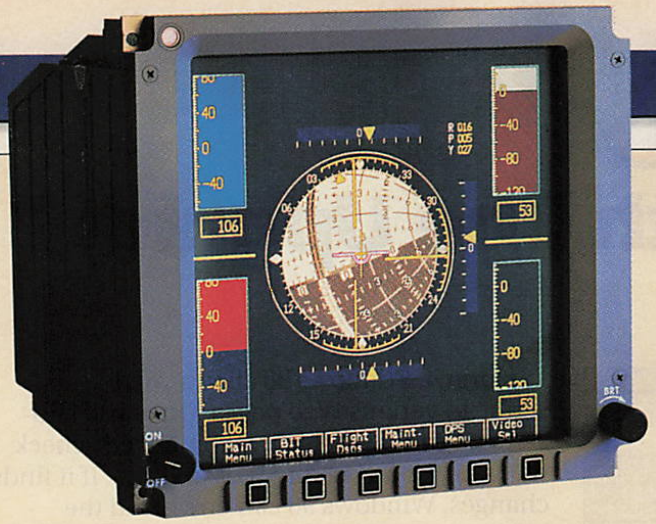

PHOTO BY HONEYWELL SATELLITE SYSTEMS/SHARI PHILLIPS

Shuttle Goes 'Tubeless'

Space shuttle pilots will soon be flying tubeless, so to speak, using flat-panel liquid-crystal screens—like those in laptop PCs—in place of electro-mechanical and cathode-ray-tube displays.

Honeywell, based in Phoenix, has built the multi-functional electronic display subsystem (MEDS), shown above, to display a shuttle's speed, altitude, position and direction, along with the status of its various subsystems.

Nine MEDS units will be installed on each shuttle's forward flight deck. Two will be placed in the aft deck to support payload operations.

The first MEDS is scheduled to fly in January 1999, aboard the Space Shuttle *Atlantis*.

Harbor Wave Forecasting

A computerized forecasting system being built in Israel could prevent millions of dollars in damage by giving harbor masters a 48-hour warning of boat-crunching waves.

Although not as dramatic as the giants that occur in open seas, waves that suddenly and unexpectedly appear in harbors can toss about pleasure craft and commercial vessels as though they were toys in a bathtub, explains Michael Stiassne, of Technion-Israel Institute of Technology.

"Waves go through a substantial change when they move from deep to shallow water," he says. This is where the new system, called Sea 21, becomes crucial. It uses software to analyze weather, current and wave data, to create a local port forecast. The system must be customized for each port.

The first Sea 21 forecasting system is now being installed in the Israeli port town of Haifa. PM

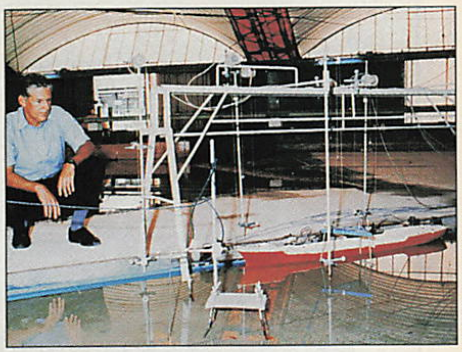

PHOTO BY TECHNION

Stiassne tests Sea 21 in a model harbor. The wave-forecasting system must be customized to account for the harbor's shape and historic weather patterns.

BEST SMOKE OF THE DAY

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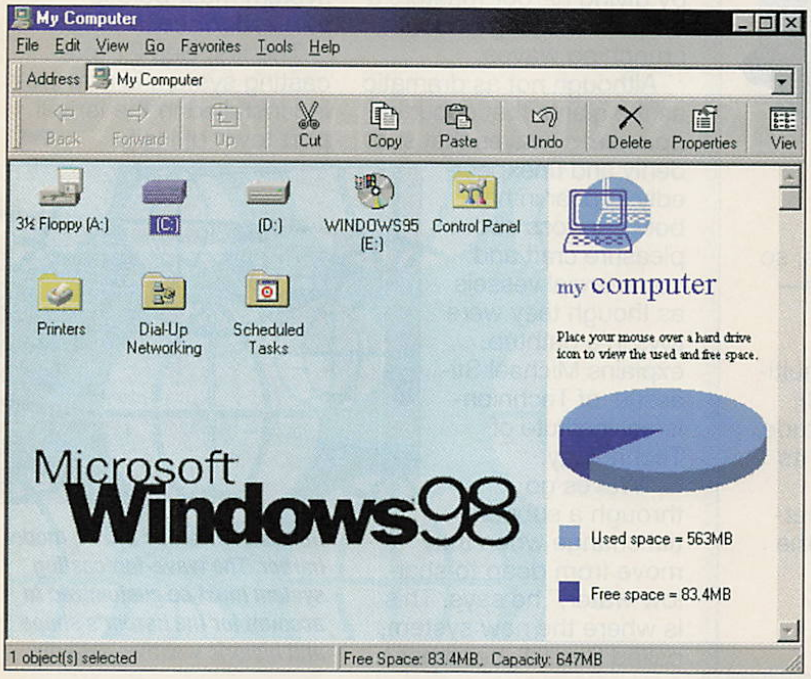
Technology

Windows 98: Worth The Upgrade?

BY KIM KOMANDO



Screen shot of Windows 98

Unlike previous versions of Windows, there probably won't be too many people standing in line at midnight to be the first ones to purchase Windows 98 when it's introduced later this year. Why? Because Windows 98 looks pretty much the same as Windows 95, with the service packages and Internet Explorer 4 installed. So who needs it?

Maybe you do. There is enough new stuff to make the upgrade worth considering.

First off, you'll find several long-needed system tools designed primarily to pump up the speed, take advantage of new technologies, and enable users to troubleshoot problems. And now Internet Explorer 4 is integrated into Windows 98. The desktop itself operates like a Web browser. Traditional Web browsing functions, including BACK and FORWARD buttons, are available on-screen, which makes getting around easier.

COMPUTERS

The Active Desktop allows you to display Web content as part of your Windows desktop. If you have a high-speed, continuous Internet connection you can, for instance, have the latest stock quotes available at the click of the mouse. But modem users with a 28.8Kbps connection or slower should steer clear of this option.

As with the stand-alone version of Internet Explorer 4, Windows 98 allows you to subscribe to various Web pages. Once you subscribe, Windows 98 will automatically check the page for any changes or updates. If it finds changes, Windows 98 can download the page—depending on the schedule you set—graphics and all, so you can read it at your leisure, even when you're not online.

There are other, more subtle changes, too. A double-click has been knocked down to a single-click, and what once required a single-click requires no click at all. To select a file in Windows 98, you simply move the mouse pointer over its icon. If you want to open the file, you click once. If you've been single-clicking files for years just to select them, I can guarantee that you're going to unintentionally open dozens of files before you finally get used to this feature.

Files Galore

Instead of visiting the Microsoft Web site to see if any new bug fixes or service packages are available, registered users can subscribe to a free online service called Windows Update.

Once you subscribe, your computer will automatically check with Microsoft via the Internet to see if your system needs any new or updated components such as program fixes and driver updates. If you do, the Windows Update will download and install them for you.

The System File Checker will monitor your computer to make sure all the necessary operating system components are there. If it finds that something is missing, the program will automatically restore the missing component. To complement the System File Checker, the Disk Cleanup Tool looks for files and helps you remove files that you still have but no longer need. That includes any files that may be clogging up your browser cache.

The Registry Checker scans the Windows registry for problems, automatically repairs corrupted registries and keeps backup copies.

Like Windows 95, Windows 98 includes the system utility ScanDisk, which checks the integrity of the hard disk, and Defrag, which arranges files in contiguous order for faster file access. The biggest difference here is the way that Defrag works. Now, Defrag arranges the files so that those most frequently accessed are placed on the outer cylinders of the hard disk. This decreases file load speed by about 30%.

(Please turn to page 34)

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Pumping Up Hardware

Microsoft claims that Windows 98 is the fastest version ever. They're right. There's no 2-second "Starting Windows 98" delay. And instead of closing any open files and drivers running in memory, Windows 98 simply pulls the plug on them at shutdown. Bye-bye.

PCs meeting the new PC98 specification will shave an additional 5 seconds off Windows 98 boot time because these systems bypass much of the power-on self-test diagnostics. You can find the complete specs on the Web at www.microsoft.com/hwdev/pc98.htm.

Windows 98 replaces the antiquated FAT16 file system with a file structure called FAT32 that improves disk space efficiency substantially. A 4K file on a FAT32-formatted drive will only take up 4K, while on a FAT16 drive it would take up 36K. FAT32 can free up a tremendous amount of disk real estate, perhaps up to 27%. If you bought your PC in early 1997 or thereafter, you are probably using Windows 95 OSR2 and may already have FAT32 installed. If not, Windows 98 will ship with a one-way FAT32 conversion utility that makes it easy for you to switch your hard drive to the new format.

But FAT32 is not for everyone. Avoid it if you run multiple operating systems and are planning to install Windows 98 as well as Windows NT Workstation or Server, and you work with Windows 95 files while in Windows NT. Windows NT 4.0 can't read FAT32-formatted disks, and it's too early to say if Windows NT 5.0 will either.

Windows 98 also provides built-in support for newer hardware technologies like Universal Serial Bus (USB), which allows you to daisy-chain multiple external devices through a single high-speed serial port. You can get software drivers to run these devices on your Windows 95 system. However, I feel a little more comfortable knowing I'm using an operating system that was designed with these technologies in mind.

For entertainment, Windows 98 provides support for DVD and digital audio, meaning you can blast high-quality digital movies and audio directly from your PC to your TV or computer monitor. Support for an industry standard known as IEEE 1394 lets you control VCRs, stereos and other electronic devices right from your desktop.

Windows 98 also provides a whole new level of TV/PC integration. With the right hardware, you can watch TV on your computer monitor and search for your favorite TV programs with the built-in Program Guide that delivers programming information via the Internet. Likewise, Windows 98 supports Enhanced Television, which combines television and HTML content.

Microsoft says it's on track to ship at about the time you read this or not long after. However, there's talk that government legal proceedings with Microsoft may delay the introduction. The real question is whether Windows 98 is enough of an upgrade to make it worth your while, considering that components such as Internet Explorer and Windows 95 service packages are available as free downloads. I'd say yes, especially for those of you who don't need Windows NT's increased security features and stability. Otherwise, you might want to wait until the clock chimes again in Redmond, Washington, announcing the release of Windows NT 5.0, which should come in late 1998 or possibly early 1999. Now *that* will be an upgrade.

Sympathy For The Eardrums

BY TOBEY GRUMET

PHOTO BY STAR FILE INC./BOB GRUEN

The Stones tear up Madison Square Garden with new X-Array system.

If you go to a live concert you expect to hear great sound. Unfortunately, that's just wishful thinking. Sound systems used by touring groups are, at best, a compromise that can deliver pretty good sound under all conditions and still remain mobile. The Rolling Stones, one of the hottest bands around, would have none of that on their recent "Bridges To Babylon" tour. Especially when tickets were being scalped on the streets of New York for as much as a grand a pop. So the Stones' touring company turned to Michigan-based Electro-Voice Inc. and its new X-Array Expanded Resolution Loudspeaker System.

ENTERTAINMENT

With a price tag of $3 million, X-Array Expanded Resolution was touted as revolutionary, its premise being that the music should sound the same, no matter where you're lo-

(Please turn to page 38)

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cated in the arena. The X-Array also was supposed to provide better overall sound quality by "learning" to adjust itself from concert venue to venue.

Generally, the farther you are from a sound source, the lower the volume. That's because high-frequency sound waves don't travel well. The X-Array system seemingly does away with that principle—and several laws of physics. On the Stones tour, the system consisted of several rows of speakers arranged in a semicircular, egg-shaped cluster. For the New York shows, four clusters were used. The top rows of speakers were aimed at the seats in the back of the arena and set with more high-frequency equalization. The bottom rows, aimed at the seats in front, had more low-frequency content. This ensured that the sound would not be too bright in front and not indistinct, or muddy, in back.

Each rack of amplifiers powering a row of speakers had its own digital processor that provided what is called time alignment for those speakers. The computers figured out what was required to adjust the speakers so that the sound was equal no matter where you sat. *Voila!* No more bad seats.

In effect, each row of speakers was spatially "moved" forward or backward in relation to their distance from the seats, and according to the frequency response and loudness of the music being played. So the sound hit every part of the arena at exactly the same time. X-Array claims to clear up another problem—equalization (EQ). A new process called ring-mode decoupling (RMD), essentially high-tech bass and treble controls, solves that. EQ has a tendency to become muddy as a show progresses. That's because engineers run their sound checks in an empty arena at low volumes. During the concert, when volume is cranked, certain frequencies get lost in the mix. Volume exacerbates another problem: speaker resonation. During a concert, these resonances can collide and create ringing noises that muddy the sound. The resonance is aggravated by loudspeaker arrays, which are commonplace in every large concert system.

X-Array lets loudspeakers sound the same at low volumes as at high volumes. To accomplish RMD, Electro-Voice changed the material of the cone inside the speakers as well as the amount of separation between the mid-bass driver cone and its frame. Foam padding was also added as damper material.

Was it all worth it? After watching Jagger and the band strut around for over 2 hours from the nosebleed section of Madison Square Garden, I'm not so sure. The sound was definitely good, but it wasn't overwhelming. Keep learning X-Array, you'll get it right! PM

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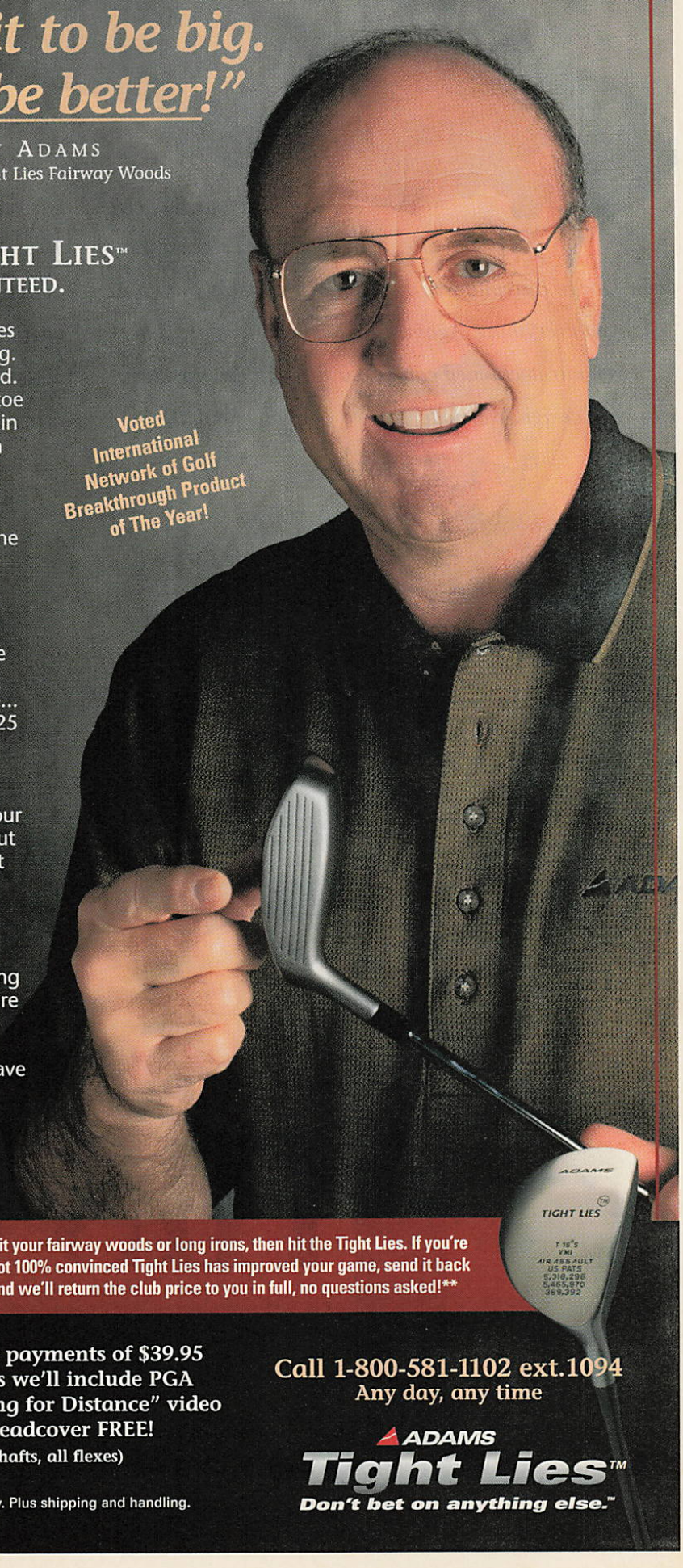

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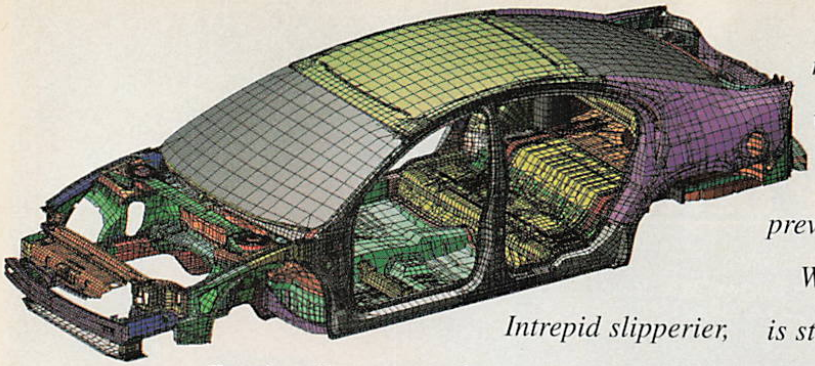

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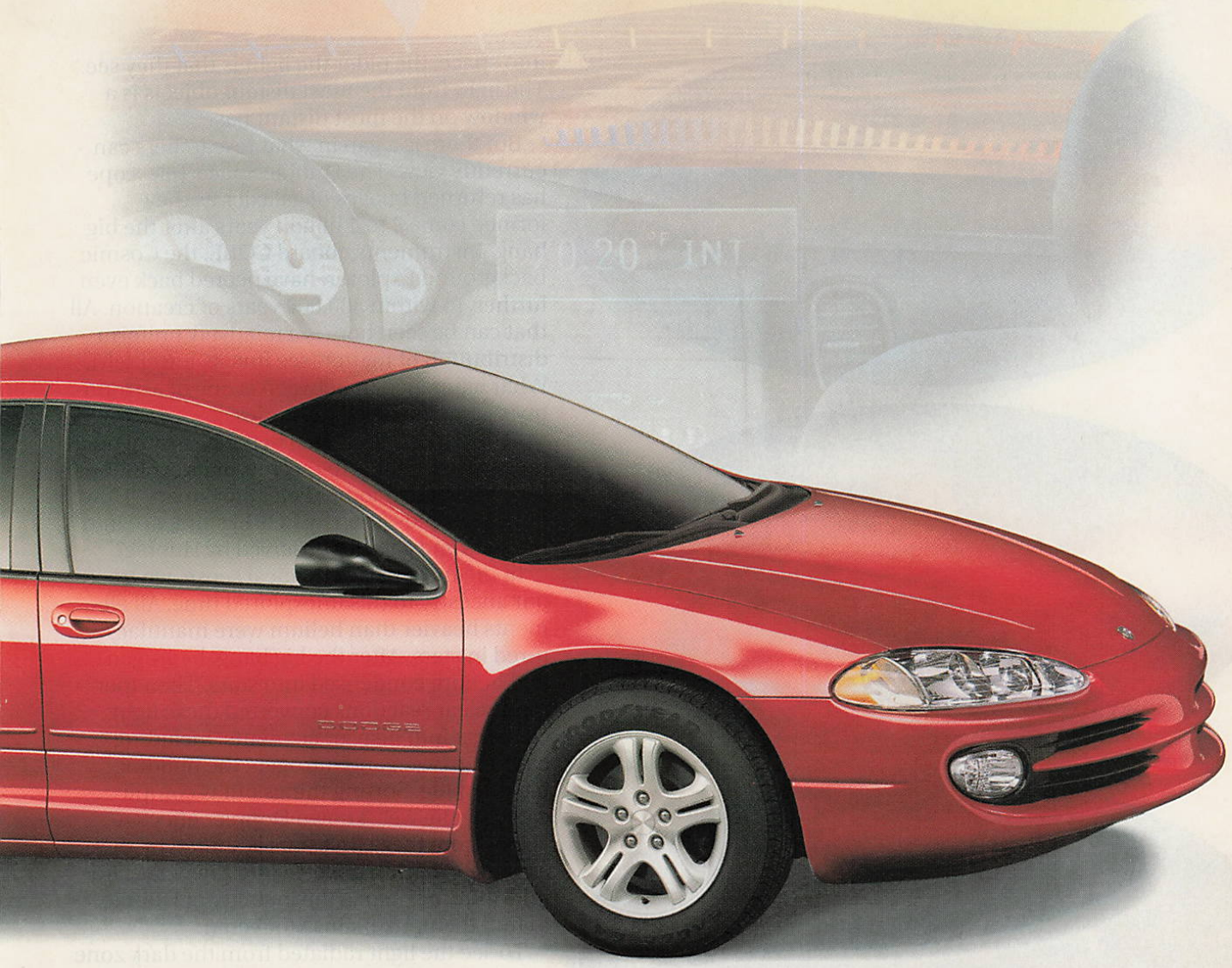

cab-forward
ep forward.

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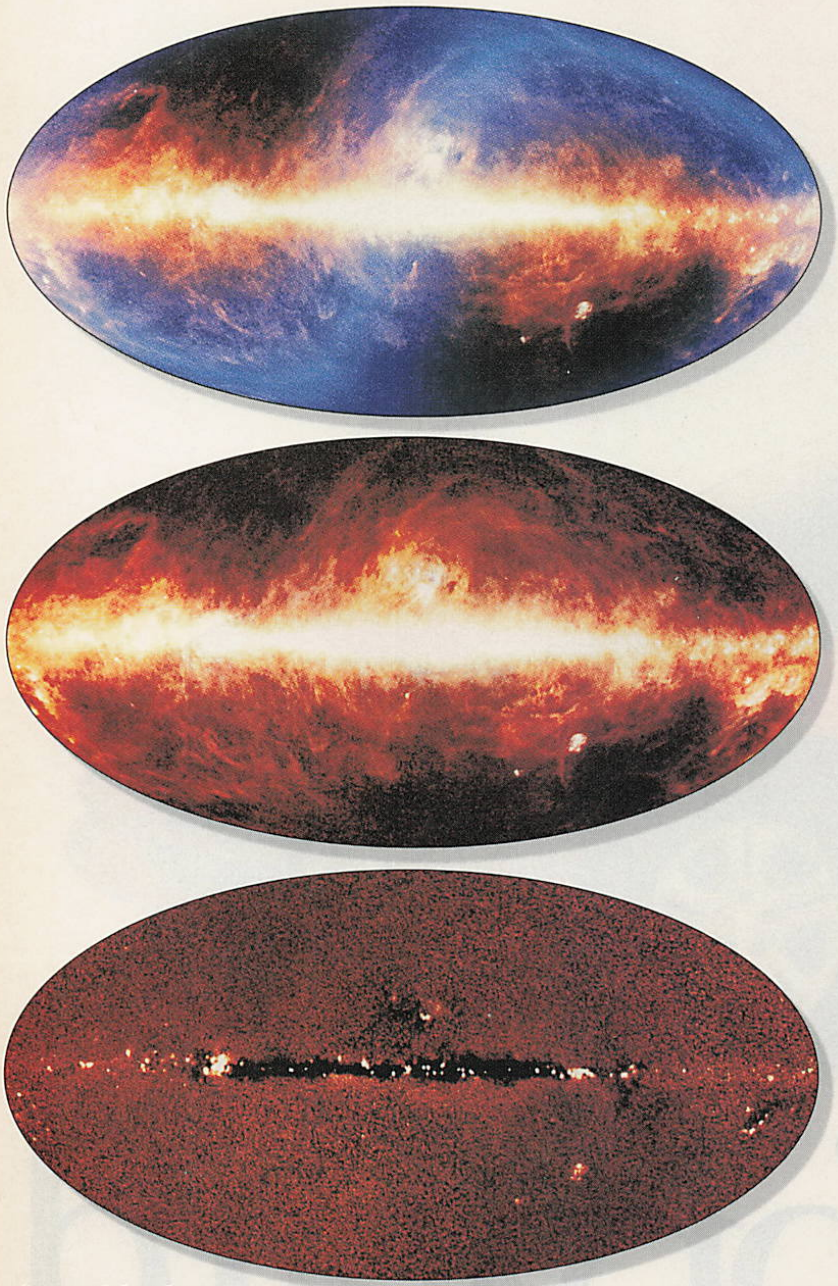
Science

Peering Into The Dark Zone

BY JIM WILSON



Images taken by the Cosmic Background Explorer, 559 miles above Earth, show the full sky as seen in infrared (top) and with the glow of solar dust removed (center), revealing a uniform cosmic infrared background (bottom).

A new orbiting telescope that looks at the cosmos with technology akin to night-vision goggles promises to give astronomers their first look at the most mysterious part of the universe, the so-called dark zone.

This region earns its sinister name because it cannot be viewed using current telescopes. The universe has been expanding since the "big bang" set things in motion about 15 billion years ago. Light from the most distant parts of the universe has taken the longest to reach Earth, so the deeper astronomers peer into space, the older the light is that they see. The light from the most distant objects is a window on the most distant past.

But there is a gap in what researchers can currently view. The Hubble Space Telescope has returned images of galaxies as they formed some 2 to 4 billion years after the big bang. Instruments aboard COBE, the Cosmic Background Explorer, have peered back even further, to within 300,000 years of creation. All that can be seen here is a relatively uniform distribution of matter (see image, lower left). What happened in between is one of astronomy's great unsolved mysteries.

"The dark zone is a gap in the history of our universe that holds the secrets of its evolution," says NASA astronomer Peter Stockman. "How did these seeds [seen by COBE] condense into the stars and galaxies observed by Hubble?"

In the most basic chemical sense, we trace our ancestry to this unexplored time. All elements heavier than helium were manufactured in stars. After the big bang, hydrogen and helium condensed into stars. Then thermonuclear reactions converted these light elements into heavier elements, including carbon, oxygen and nitrogen, the building blocks of life. Sorting things out is complicated by the well-known Doppler effect. "Light from these first stars is shifted by the expansion of the universe into the near- and mid-infrared, hence the inability of Hubble to find them," explains Stockman.

To see the light radiated from the dark zone requires technology comparable to a pair of orbiting night-vision goggles. Yet to be formally named, the proposed instrument's working designation is the "next generation space telescope," or NGST.

Like Hubble, NGST will spend its life in orbit. But this is where the similarities end. While Hubble detects light across a wide range of frequencies—from ultraviolet down through visible light and partway into near-infrared—NGST will concentrate on the near- and mid-infrared parts of the electromagnetic spectrum.

Radiation in this region has a wavelength from 1 to 20 microns. Since the human eye is tuned to the 0.35- to 0.8-micron region, the light is invisible. NGST will convert this infrared radiation first into electronic data and then into images visible to the human eye.

Thus equipped, NGST will make it possible for astronomers to see the infrared-shifted light coming from near the edge of the uni-

PHOTOS BY MICHAEL HAUSER (SPACE TELESCOPE SCIENCE INSTITUTE), THE COBE/DIRBE SCIENCE TEAM, AND NASA OFFICE OF SPACE SCIENCE

verse and also to peer through the dust that obscures most of the star-forming regions in nearby galaxies.

"Much of the universe is hidden from our view by dust. Although each dust grain is tiny—less than the width of a human hair—it is remarkably effective at scattering and absorbing visible and ultraviolet light," says Stockman. "Some star-forming galaxies are so dusty that we can only see the optical and ultraviolet light from the stars within the outermost skin of the star-forming regions."

Observations currently being made by Hubble, for example, suggest that stars are being born in the constellation of Orion and in the Eagle nebula. The stars themselves, however, are hidden inside dusty cocoons. Since infrared light is less impeded by dust than visible light is, NGST will be able to peer deep inside these clouds.

"NGST will allow astronomers to study the first protogalaxies, the first star clusters as they make their first generation of stars, and the first supernovae as they release heavy chemical elements into the interstellar gas," says Stockman.

To see into the dark zone, NGST will need to be positioned where effects of stray light and heat from Earth are minimized. Astronomers have two locations in mind. The first is known simply as L2. It is one of five Lagrangian (L)—or liberation—points in the Sun-Earth gravitational system, where the gravitational forces of the two bodies balance, creating stable "parking spaces" for satellites.

"The Sun, Earth and Moon are always on one side of the telescope," explains Stockman. "And the constant distance from the Sun provides a stable thermal with continuous solar illumination for generating on-board power."

The other possibility is a Sun orbit that takes NGST between 1 and 3 astronomical units (AU) from the Sun, 1 and 4 AU from Earth. One AU is about 93 million miles, the average distance between the Earth and the Sun. Known as the 1×3 AU orbit, it would be more difficult to reach than L2, but the added distance has a powerful advantage.

"The tradeoff in NGST sensitivity is such that a 6-meter [19-ft. 8-in.] telescope at 3 AU from the Sun has comparable or superior performance to an 8-meter [26-ft. 3-in.] telescope at L2," says Stockman.

Building either size mirrors will be a big challenge, says John Humphreys, manager of NGST operations at NASA's Marshall Space Flight Center. "We have little information on what happens to materials going from room temperatures to the [cryogenic] temperatures required for the NGST."

Moving into orbit won't be easy either. The space shuttle—which delivered Hubble to its low-Earth orbit—doesn't make deliveries this far out of town. NGST will have to ride aboard an expendable rocket. The choice of launch vehicles will determine the total weight of the observatory. It will also affect the price tag.

The estimated cost of building NGST and operating it over its 10-year lifetime is $900 million. Delivering it into space could cost up to $450 million, depending on the system used.

If NGST were to fly aboard the Rolls-Royce of the rocket fleet, the Titan IV, an observatory placed at L2 could weigh as much as 16,027 pounds. In the 1×3 orbit the weight would be limited to 5344 pounds. The ticket to either location would cost NASA about $450 million.

On the other end of the scale, the cheapest ride—$60 million—would be aboard Sea Launch (see "Water Rockets," page 52, April 1996). A launch from this floating space port could lift an observatory as heavy as 7275 pounds to L2, but not more than 661 pounds to the 1×3 orbit.

Last year, NASA's Goddard Space Flight Center, TRW and Lockheed Martin led design teams to three different concepts for NGST.

"These showed that such a mission could be done if several key technologies, such as very lightweight mirrors, could be established in the next five years, at the time when NASA will select the telescope design and its orbit," says Stockman.

If all goes well, NGST will launch in 2007. To overlap with the mission, NASA is considering extending Hubble's life to 2010.

What happens when NGST arrives on-orbit is anyone's guess. "We have many different and conflicting predictions of what we'll see when NGST begins sending its images to Earth," says Stockman. "That we don't know the outcome is why it is such great science." PM

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b) In their digital design system.
c) In their spartan cubicles.
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2. What are some benefits of Intrepid's improved torsional stiffness?

a) World peace and stability.
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d) Better night visibility and improved memory.

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Intrepid The New Dodge

Outdoors

Jet Bikes Go Green

BY JIM GORANT

"Beware Of Alligator" signs are fairly common in the swampy heart of Florida. But this particular sign is troubling because it's just 10 ft. away as I climb onto a relatively unstable jet bike. "Don't worry," says my host, "they won't bother you unless you make them angry."

That's great. Except that jet bikes, also known as personal watercraft (PWC), seem to make everyone angry. They're loud, they pollute and they can be dangerous.

The PWC version of Ficht direct injection features a new management module, smaller stator and the same ingenious injectors.

But this PWC is supposed to be different. It's the first jet bike built with Ficht direct-injection technology. Over the past two years, Ficht engineering has made OMC's Johnson and Evinrude outboards quieter and 30% more fuel efficient, while cutting their hydrocarbon emissions by 70%. I'm here to see if the Ficht system can do the same for jet bikes.

For comparison purposes, another tester mounts an identical, normally carbureted bike. He asks if the gator sign is for real. "A few years ago," someone confirms, "a kid jumped in here and an alligator ate him."

"I get the feeling that when you walk around here in a wet suit," I tell him just before we fire up the engines, "people call you chum, but they don't mean pal."

Glorified Hedge Trimmer

In 1996, the EPA mandated a 75% reduction in hydrocarbon emissions for marine 2-stroke engines. For PWCs, the program begins with model year 1999 and phases in over seven years. Earlier this year, Sea Doo introduced the GTX RFI, a bike that meets the emissions requirements for 2001. Mercury and Orbital, which teamed up to create a direct-injection system for outboards, also are working on one for PWCs.

But OMC leads the field: Its model-year 1999 engines will meet the final 2006 emissions standards, and it recently announced that its Ficht system will be standard on all Polaris watercraft. It's the same technology found in the company's 4- and 6-cylinder outboards that range from 90 to 175 hp. It will also be in the 225 introduced later this summer.

The Ficht system works by injecting carefully measured plumes of fuel directly into the combustion chamber under high pressure. A low-pressure pump feeds fuel from the tank to a vapor separator and fuel cooler, ensuring that the system is always primed with good fuel. From there, a relatively high-pressure pump (about 30 psi) delivers the fuel to the injectors.

An engine management module (EMM) with a 16-bit microprocessor receives input from sensors that monitor throttle position, engine temperature, air temperature, crankshaft position and barometric pressure. Based on these data, the EMM sends an electronic pulse to the injector pump. The pulse completes a circuit, creating a magnetic field that moves a piston within the injector. When the piston is driven down, it opens the nozzle and injects fuel into the cylinder.

The EMM turns the voltage on and off rapidly, cycling the injector piston more than 150 times per second and raising the injection pressure to as much as 400 psi. The duration of the pulse determines how much fuel is injected, and the pressure atomizes the fuel, so it burns more efficiently. A high-frequency CD ignition fires at rates up to 15 times per engine revolution, which ensures complete fuel burn. Since the ports are never open while fuel is present, the engine burns efficiently and cleanly.

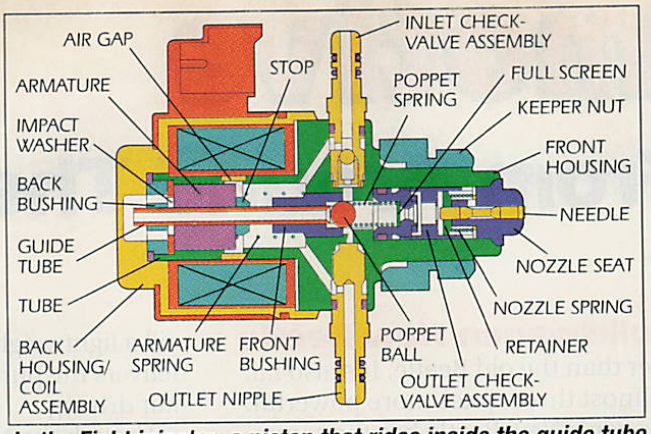
The genius of the system is that it's so simple. The original had only four parts: EMM, injectors, stator and ignition.

On the PWC version the injectors stay the same. And these little technological marvels are so straightforward that it only takes

about 5 minutes to remove, disassemble, clean and reassemble one.

The ignition system has been incorporated into the EMM, even as the EMM has been reduced in size, and a new, smaller stator produces 850 watts. This power not only charges the battery, but also provides initial power to the ignition system, which means Ficht can now work off a pull-start.

OMC plans to bring Ficht to every variety of 2-stroke motor, so one day you may be able to swap injectors between your outboard and your weed wacker.



In the Ficht injector, a piston that rides inside the guide tube depresses the poppet ball and forces fuel out the needle.

Fun Runner

The good news is that the Ficht-powered jet bike provides the speed and low-end torque 2-strokes are known for. During testing, our two bikes stayed side by side throughout the rpm range, with the Ficht-powered bike registering 51.6 mph and the carbureted machine 51.7 mph at the top end. (The carbureted engine ran exceedingly rough and smoky. We were told it was right out of the box, which means it hadn't been broken in.)

OMC's dynamometer tests indicate that the two engines produce the same peak horsepower, and at certain points along the power curve the Ficht engine actually produces more power. The same tests also show that a Ficht-powered PWC engine burns 35% less fuel.

On the downside, the Ficht didn't show the hoped-for reduction in noise. Both jet bikes registered 84 dBAs at top speed and 69 dBAs at idle. According to OMC engineers, Ficht technology makes outboards quieter because it eliminates the intake noise of a carbureted outboard. But since PWCs don't produce much intake noise to start with, there's no benefit in terms of noise.

The Ficht bike ran smooth and handled well, but it seemed a tad sluggish coming out of tight turns. This is probably because it's 30 pounds heavier than its non-Ficht sibling. And the Ficht engine did produce some smoke. Smoke alone is not an indicator of hydrocarbon emissions, though, and tests in OMC's EPA-certified test cell have shown a 76% reduction in emissions.

Overall, the Ficht PWC engine seems ready to usher in an age of efficient fuel-injected bikes. For those who hate the noise of jet bikes, that's actually bad news: They're as loud as ever—and they don't have to stop to refuel as often. But the reduction in emissions should make everyone happy, even the alligators. And Lord knows, you don't want to get them mad. **PM**

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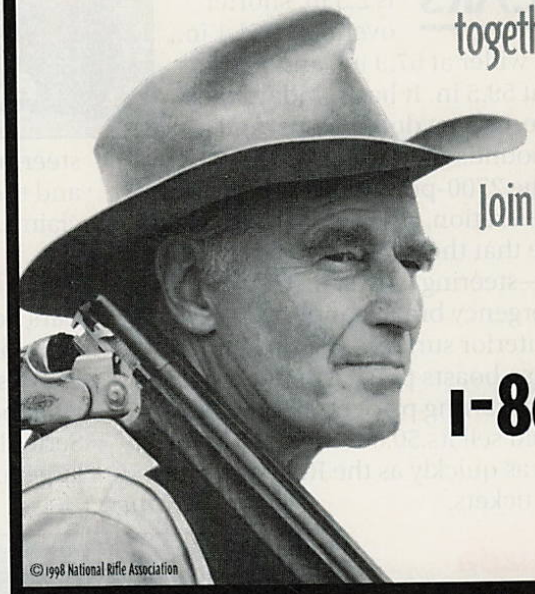

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Automotive

Reports From Around The World

1998 Volkswagen New Beetle

It's far larger than the old Beetle. It's also far safer and almost three times more powerful. But Volkswagen's New Beetle has the same spirit of fun that the old car had, in spades.

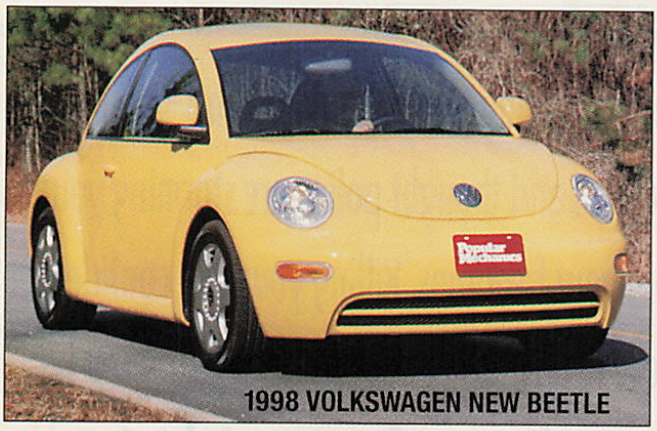

PHOTO BY JIM McCRAW

1998 VOLKSWAGEN NEW BEETLE

It's a front-drive 2-door sedan, based on the Golf chassis, that uses a 2.0-liter 115-hp 4-cylinder gas engine or an optional 1.9-liter direct-injection turbodiesel engine, with a 5-speed or 4-speed automatic transmission. A 1.8-liter 150-hp turbo engine will be along later.

Compared to the original, the New Beetle's wheelbase is 4.4 in. longer, at 98.9 in., but the new car is 2.3 in. shorter overall at 161.1 in., a full 6.9 in. wider at 67.9 in., and half an inch taller at 59.5 in. It has standard dual airbags, side-impact door beams, and about 700 pounds more weight.

NEW CARS

Driving the 2700-pound Beetle reveals it has the acceleration, braking, cornering and smooth ride that the old car lacked. The interior design—steering wheel, instrument pod, shifter, emergency brake handle, door panels and other interior surfaces—is simply beautiful, and it also boasts plush, supportive front buckets. At a starting price of $15,700, Volkswagen should sell its 50,000-unit U.S. allotment about as quickly as the Rolling Stones sell concert tickets.

—Jim McCraw

1999 Mazda MX-5 Miata

After more than 450,000 Miata sales worldwide and a following that borders on the devout, the time had come for Mazda to redesign the little car. And redesign it Mazda did, from the tires to the top. But, smartly, they left the car's original concept alone. It is still a lightweight, affordable roadster that delivers the pure enjoyment of wind-in-the-hair driving.

Though the Miata is still no rocket ship, the car's 1.8-liter dohc Four now makes 140 hp (138 hp in California). With more power, and a negligible weight increase, the '99 Miata is livelier than last year's car, with either its short-throw 5-speed or the 4-speed automatic. The fact that Mazda was able to widen the car's track to add cornering stability, significantly increase its chassis rigidity, add a glass backlite and 42% more trunk space without markedly increasing the car's heft is truly an engineering feat. The old Miata R, the boy-racer version, is replaced by the Sports Package. It adds 15-in. wheels and a spoiler kit.

Inside, things are cozy, but the layout is simple and ergonomic. The fat, leather Nardi steering wheel is cool, the Bose stereo cranks and the built-in wind blocker does what it claims.

1999 MAZDA MX-5 MIATA

—Scott Oldham

1999 BMW 3 Series

Cars nearing the end of a 7-year production cycle often show diminished demand, but BMW's 3 Series sales are at an all-time high. So what better time to start phasing in a new 3 Series lineup? Larger inside and marginally larger outside, the new sedans are propelled

(Please turn to page 48)

1999 BMW 3 SERIES

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5 mg "tar," 0.5 mg nicotine av. per cigarette by FTC method.

SURGEON GENERAL'S WARNING: Smoking By Pregnant Women May Result in Fetal Injury, Premature Birth, And Low Birth Weight.

by a new 2.3-liter inline Four and a retuned, stronger 190-hp Six. Unfortunately, U.S. buyers won't get to opt for the excellent Steptronic semiautomatic that will be offered in Europe. Fortunately for us, though, the 5-speed automatic transmission, which is optional here, uses adaptive logic and does a creditable job. And there's always the manual.

BMW's theme for this car is safety, and standard equipment includes Cornering Brake Control (BMW-speak for yaw control), front-seat side airbags and BMW's exclusive Head Protection tubular airbags in the headliner. In addition, rear-seat side airbags are optional. We'd also check off the order box for the xenon headlamps and the in-dash navigation system.

While the sedan will be on sale late this summer, the current coupe and convertibles will carry over. Look for a new coupe late in 1999, and a convertible in the spring of 2000, perhaps followed shortly by a station wagon.

—Mike Allen

1999 Audi A6 Avant

You call it a wagon, Audi calls it Avant. Whatever. Audi has a new 1999-model station wagon built off the A6 chassis. The formula is simple. Take the proven A6 sedan, rework the rear end, roof and rear doors, and exploit the 2.8-liter V6 and 5-speed automatic Tiptronic-shift powertrain. Oh, one more detail: Make the all-wheel-drive Quattro standard. In execution, Avant offers a number of its own features: a distinct body style with a longer windshield, flatter roofline, angled rear hatch

1999 AUDI A6 AVANT

and unique shapes for the rear bumper and taillights. Still, you see the Audi "shoulder" between the lower body and greenhouse. Also, there's an optional, rear-facing third seat for two.

Though the Avant weighs about 100 pounds more than the A6 sedan, its fuel economy (17 city/26 highway) and performance are similar. The rear seat folds into an angled floor "without fuss." The seat is set up for three and splits ⅓-⅔ as needed. A small storage compartment nestles below the rear floor. The spare is also stowed below the rear floor.

—Jim Dunne

DETROIT SPY REPORT

BY JIM DUNNE

1999 Dodge/Plymouth Neon

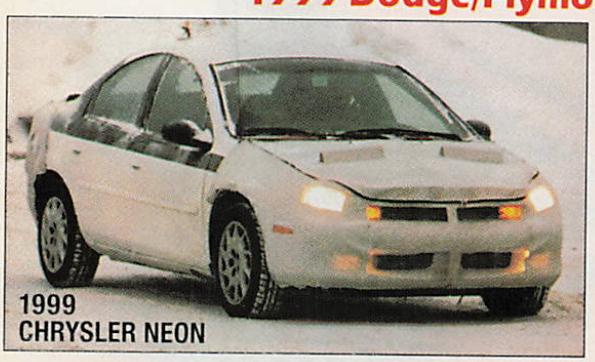


PHOTO BY NICHOLAS A. TWORK

1999 CHRYSLER NEON

We caught this next version of Chrysler Corp.'s Neon out testing in the northern climes. The car, due out as a 1999 or maybe '99½, has a shorter wheelbase—as much as 5 in. less—than the current model's 104 in. This change is dictated by the export models that must meet European expectations of a smaller turning diameter. At first glance, the car appears to be a slightly altered version of the '98 model. Despite its blunt nose and the rounded top profile of the greenhouse, though, the severely angled windshield is a giveaway to its true identity. Wheel design is also new, unlike anything out of the Chrysler studios to date. Cold-weather testing is a normal stage in new-car development. Engineers measure heater/defroster warmup time and effectiveness, snow ingestion of the engine, engine cooling and heating, and brake effectiveness.

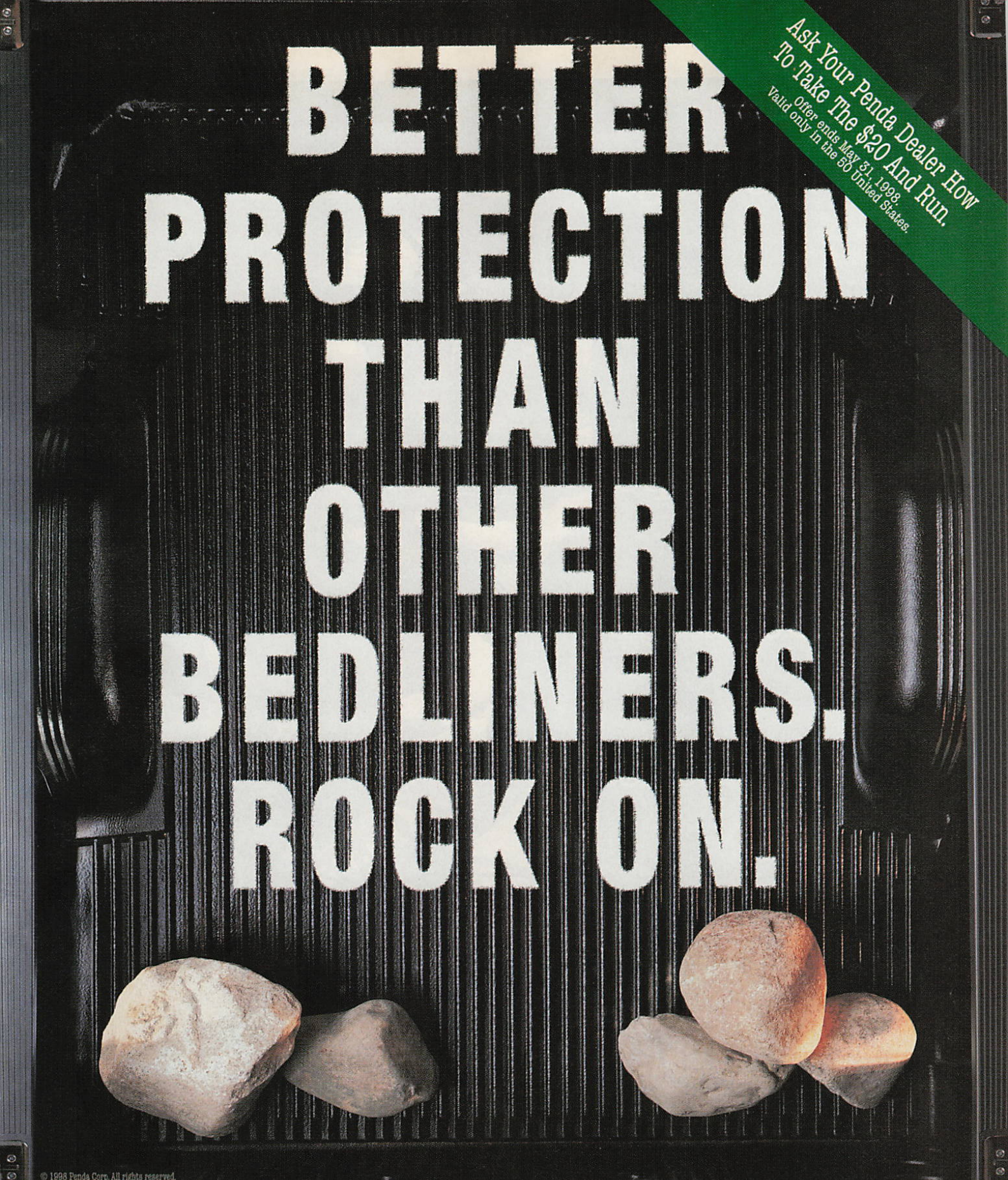
1999 Cadillac DeVille

Cadillac is preparing a completely new DeVille for the 1999 model year. Even with the extensive camouflage, this unauthorized photo shows many of the details that make the new car different. At the front is a large, rectangular grille opening, similar to current designs. Look closely and you see the oversize headlights that extend upward to curve over the top of the fascia. The lower fascia is marked by grille-like air intakes plus a blank spot for a license plate. The side view is dominated by a high beltline and an angled C-pil-

(Please turn to page 52)

1999 CADILLAC DEVILLE

PHOTO BY JIM DUNNE



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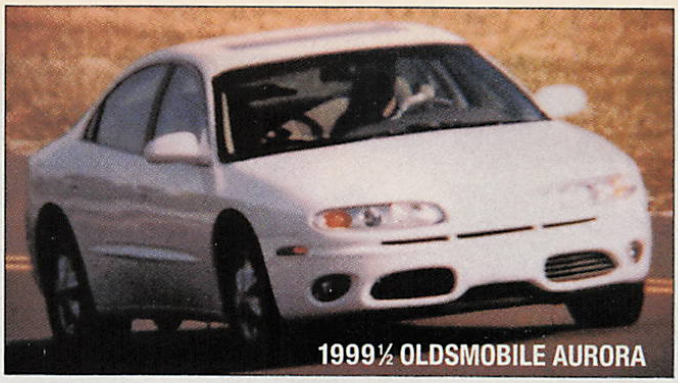
1999½ OLDSMOBILE AURORA

PHOTO BY NICHOLAS A. TWORK

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EUROPE SPY REPORT

BY MIKE ALLEN

1999 Porsche Supercars

PORSCHE 911 GT 2

PHOTO BY HIDDEN IMAGE

The midnight oil's been burning bright in Stuttgart lately, and here are the fruits of that toil: A pair of cars to lust after. The 911 GT 2 (street version of the racing-only 911 GT 1) will probably never be sold in the United States, but that's a moot point for most of us anyway. Styling is pegged to the new 911, and the engine is undoubtedly a water-cooled turbo flat-6. Horsepower? Plenty. The car we will see here in 1999 or so is the new 911 Turbo. With all-wheel drive, the 3.4-liter flat-6 will produce at least 420 hp with two turbos, and undoubtedly it will eclipse the performance of the last 911 Turbo.

PORSCHE 911 TURBO

PHOTO BY HIDDEN IMAGE

BENTLEY

PHOTO BY HIDDEN IMAGE

2000 Rolls-Royce/Bentley

Powering the new Rolls-Royce and Bentley models will be a V12 from German carmaker BMW. This will be complemented by a twin-turbo version of the current R-R V8. As is customary for Rolls and Bentley, the cars will share a chassis, but the Bentley will carry a more sporting image. More rounded than the current product, the new cars will use a BMW 5-speed automatic transmission with adaptive electronic shifting, and perhaps what BMW has labeled Steptronic manual shift. Check your local Rolls and Bentley dealer in 2000.

ROLLS-ROYCE

PHOTO BY HIDDEN IMAGE

2000 Jaguar

This 2000 replacement for the Jaguar XJ series uses a number of borrowed components from the Ford parts bin, including the platform and suspension geometry. Engines will be a Ford 3.0-liter V6 and a 284-hp 4.0-liter Jaguar V8. PM

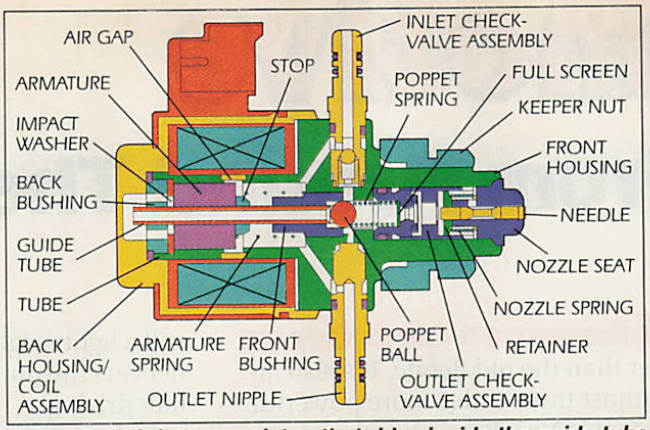
JAGUAR X200

PHOTO BY AUTO BILD/KGP

about 5 minutes to remove, disassemble, clean and reassemble one.

The ignition system has been incorporated into the EMM, even as the EMM has been reduced in size, and a new, smaller stator produces 850 watts. This power not only charges the battery, but also provides initial power to the ignition system, which means Ficht can now work off a pull-start.

OMC plans to bring Ficht to every variety of 2-stroke motor, so one day you may be able to swap injectors between your outboard and your weed wacker.



In the Ficht injector, a piston that rides inside the guide tube depresses the poppet ball and forces fuel out the needle.

Fun Runner

The good news is that the Ficht-powered jet bike provides the speed and low-end torque 2-strokes are known for. During testing, our two bikes stayed side by side throughout the rpm range, with the Ficht-powered bike registering 51.6 mph and the carbureted machine 51.7 mph at the top end. (The carbureted engine ran exceedingly rough and smoky. We were told it was right out of the box, which means it hadn't been broken in.)

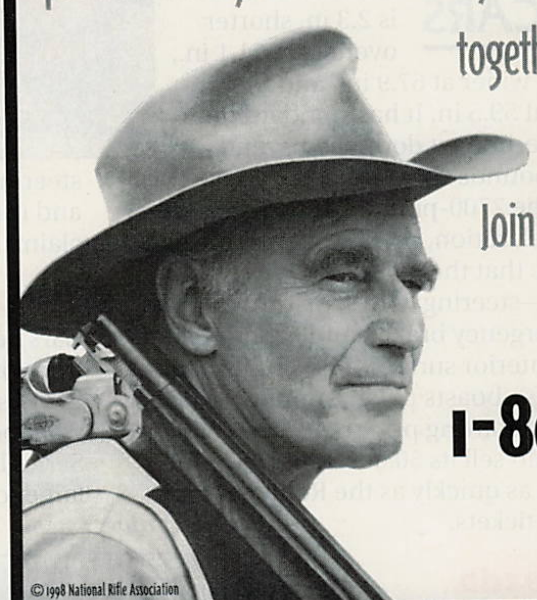
OMC's dynamometer tests indicate that the two engines produce the same peak horsepower, and at certain points along the power curve the Ficht engine actually produces more power. The same tests also show that a Ficht-powered PWC engine burns 35% less fuel.

On the downside, the Ficht didn't show the hoped-for reduction in noise. Both jet bikes registered 84 dBAs at top speed and 69 dBAs at idle. According to OMC engineers, Ficht technology makes outboards quieter because it eliminates the intake noise of a carbureted outboard. But since PWCs don't produce much intake noise to start with, there's no benefit in terms of noise.

The Ficht bike ran smooth and handled well, but it seemed a tad sluggish coming out of tight turns. This is probably because it's 30 pounds heavier than its non-Ficht sibling. And the Ficht engine did produce some smoke. Smoke alone is not an indicator of hydrocarbon emissions, though, and tests in OMC's EPA-certified test cell have shown a 76% reduction in emissions.

Overall, the Ficht PWC engine seems ready to usher in an age of efficient fuel-injected bikes. For those who hate the noise of jet bikes, that's actually bad news: They're as loud as ever—and they don't have to stop to refuel as often. But the reduction in emissions should make everyone happy, even the alligators. And Lord knows, you don't want to get them mad. **PM**

There's a cultural war raging across America. Anti-gun media, politicians, educators and thought police are storming your values. Assaulting your freedoms. Killing your self-confidence. If you don't believe it, then **why am I the only guy in Hollywood standing up for gun rights?** Fight back. Arm yourself with the courage of your convictions. Be proud of who you are and what you believe. Only then and only together can we defy them and defend our way of life. Join Me. Join Us. **Join Today.**



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Automotive

Reports From Around The World

1998 Volkswagen New Beetle

It's far larger than the old Beetle. It's also far safer and almost three times more powerful. But Volkswagen's New Beetle has the same spirit of fun that the old car had, in spades.

PHOTO BY JIM McCRAW

1998 VOLKSWAGEN NEW BEETLE

It's a front-drive 2-door sedan, based on the Golf chassis, that uses a 2.0-liter 115-hp 4-cylinder gas engine or an optional 1.9-liter direct-injection turbodiesel engine, with a 5-speed or 4-speed automatic transmission. A 1.8-liter 150-hp turbo engine will be along later.

Compared to the original, the New Beetle's wheelbase is 4.4 in. longer, at 98.9 in., but the new car is 2.3 in. shorter overall at 161.1 in., a full 6.9 in. wider at 67.9 in., and half an inch taller at 59.5 in. It has standard dual airbags, side-impact door beams, and about 700 pounds more weight.

NEW CARS

Driving the 2700-pound Beetle reveals it has the acceleration, braking, cornering and smooth ride that the old car lacked. The interior design—steering wheel, instrument pod, shifter, emergency brake handle, door panels and other interior surfaces—is simply beautiful, and it also boasts plush, supportive front buckets. At a starting price of $15,700, Volkswagen should sell its 50,000-unit U.S. allotment about as quickly as the Rolling Stones sell concert tickets.

—Jim McCraw

1999 Mazda MX-5 Miata

After more than 450,000 Miata sales worldwide and a following that borders on the devout, the time had come for Mazda to redesign the little car. And redesign it Mazda did, from the tires to the top. But, smartly, they left the car's original concept alone. It is still a lightweight, affordable roadster that delivers the pure enjoyment of wind-in-the-hair driving.

Though the Miata is still no rocket ship, the car's 1.8-liter dohc Four now makes 140 hp (138 hp in California). With more power, and a negligible weight increase, the '99 Miata is livelier than last year's car, with either its short-throw 5-speed or the 4-speed automatic. The fact that Mazda was able to widen the car's track to add cornering stability, significantly increase its chassis rigidity, add a glass backlite and 42% more trunk space without markedly increasing the car's heft is truly an engineering feat. The old Miata R, the boy-racer version, is replaced by the Sports Package. It adds 15-in. wheels and a spoiler kit.

Inside, things are cozy, but the layout is simple and ergonomic. The fat, leather Nardi steering wheel is cool, the Bose stereo cranks and the built-in wind blocker does what it claims.

1999 MAZDA MX-5 MIATA

—Scott Oldham

1999 BMW 3 Series

Cars nearing the end of a 7-year production cycle often show diminished demand, but BMW's 3 Series sales are at an all-time high. So what better time to start phasing in a new 3 Series lineup? Larger inside and marginally larger outside, the new sedans are propelled

(Please turn to page 48)

1999 BMW 3 SERIES

© Philip Morris Inc. 1998

5 mg "tar," 0.5 mg nicotine av. per cigarette by FTC method.

SURGEON GENERAL'S WARNING: Smoking By Pregnant Women May Result in Fetal Injury, Premature Birth, And Low Birth Weight.

by a new 2.3-liter inline Four and a retuned, stronger 190-hp Six. Unfortunately, U.S. buyers won't get to opt for the excellent Steptronic semiautomatic that will be offered in Europe. Fortunately for us, though, the 5-speed automatic transmission, which is optional here, uses adaptive logic and does a creditable job. And there's always the manual.

BMW's theme for this car is safety, and standard equipment includes Cornering Brake Control (BMW-speak for yaw control), front-seat side airbags and BMW's exclusive Head Protection tubular airbags in the headliner. In addition, rear-seat side airbags are optional. We'd also check off the order box for the xenon headlamps and the in-dash navigation system.

While the sedan will be on sale late this summer, the current coupe and convertibles will carry over. Look for a new coupe late in 1999, and a convertible in the spring of 2000, perhaps followed shortly by a station wagon.

—Mike Allen

1999 Audi A6 Avant

You call it a wagon, Audi calls it Avant. Whatever. Audi has a new 1999-model station wagon built off the A6 chassis. The formula is simple. Take the proven A6 sedan, rework the rear end, roof and rear doors, and exploit the 2.8-liter V6 and 5-speed automatic Tiptronic-shift powertrain. Oh, one more detail: Make the all-wheel-drive Quattro standard. In execution, Avant offers a number of its own features: a distinct body style with a longer windshield, flatter roofline, angled rear hatch and unique shapes for the rear bumper and taillights. Still, you see the Audi "shoulder" between the lower body and greenhouse. Also, there's an optional, rear-facing third seat for two.

1999 AUDI A6 AVANT

Though the Avant weighs about 100 pounds more than the A6 sedan, its fuel economy (17 city/26 highway) and performance are similar. The rear seat folds into an angled floor "without fuss." The seat is set up for three and splits ⅓-⅔ as needed. A small storage compartment nestles below the rear floor. The spare is also stowed below the rear floor.

—Jim Dunne

DETROIT SPY REPORT

BY JIM DUNNE

1999 Dodge/Plymouth Neon

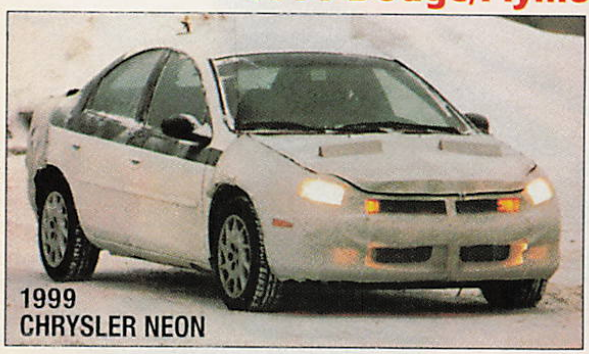


PHOTO BY NICHOLAS A. TWORK

1999 CHRYSLER NEON

We caught this next version of Chrysler Corp.'s Neon out testing in the northern climes. The car, due out as a 1999 or maybe '99½, has a shorter wheelbase—as much as 5 in. less—than the current model's 104 in. This change is dictated by the export models that must meet European expectations of a smaller turning diameter. At first glance, the car appears to be a slightly altered version of the '98 model. Despite its blunt nose and the rounded top profile of the greenhouse, though, the severely angled windshield is a giveaway to its true identity. Wheel design is also new, unlike anything out of the Chrysler studios to date. Cold-weather testing is a normal stage in new-car development. Engineers measure heater/defroster warmup time and effectiveness, snow ingestion of the engine, engine cooling and heating, and brake effectiveness.

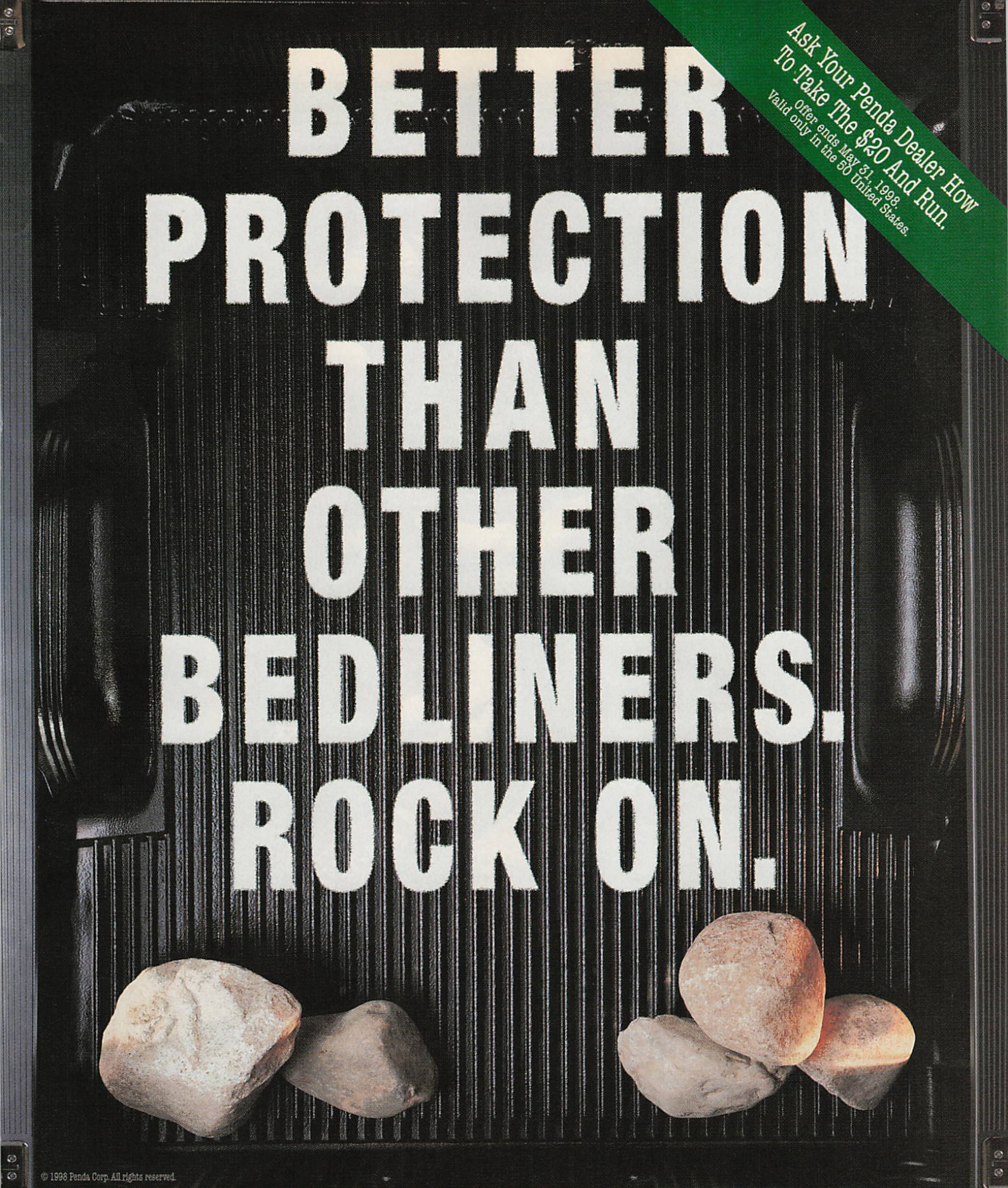
1999 Cadillac DeVille

Cadillac is preparing a completely new DeVille for the 1999 model year. Even with the extensive camouflage, this unauthorized photo shows many of the details that make the new car different. At the front is a large, rectangular grille opening, similar to current designs. Look closely and you see the oversize headlights that extend upward to curve over the top of the fascia. The lower fascia is marked by grille-like air intakes plus a blank spot for a license plate. The side view is dominated by a high beltline and an angled C-pil-

(Please turn to page 52)

1999 CADILLAC DEVILLE

PHOTO BY JIM DUNNE



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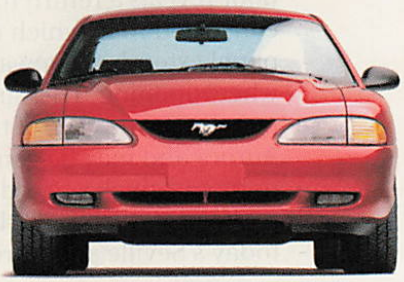

Blink during a NASCAR race and you risk missing the thrill of a lifetime. Of course, in a world that moves at 200 mph, we tend to work fast. At Ford, we're not about to slow down for anyone, but we do want to invite you in for a closer look. Into a sport where an entire work week is squeezed into a Sunday afternoon. And where our greatest success goes beyond the finish line. So get in tight with Ford Racing. But do it quickly.

Ford

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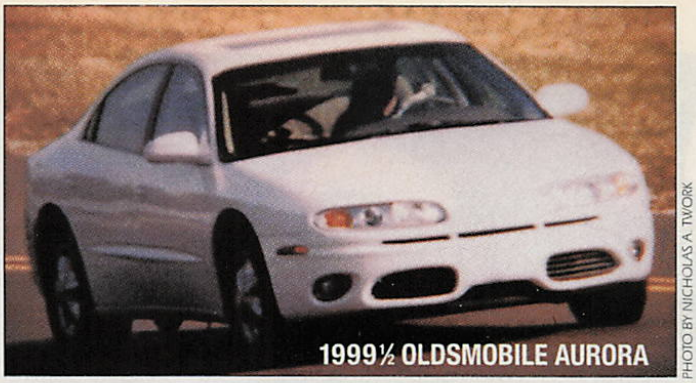

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PHOTO BY HIDDEN IMAGE

PORSCHE 911 TURBO

BENTLEY

PHOTO BY HIDDEN IMAGE

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JAGUAR X200

PHOTO BY AUTO BILD/KGP

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SAVAGE® 650

INTRUDER® 800

MARAUDER™ 800

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Great Stuff

From home improvement to outdoors, automotive to electronics, here's the newest gear you'll want to own.

Talk Of The Town

Samsung Telecommunications is touting its SCS-100 CDMA smart phone. In addition to phoning, it enables you to do many things. You can also access a personal planner and address book. Accessories include a lighter charger, travel charger, wired fax/data adapter, wired keyboard and hands-free car kit. The price is approximately $750 at consumer electronics and computer stores. Contact Samsung, 3500 Maple Ave., Dallas, TX 75219; 214/443-0002.

Let It Bleed

Bleeding brakes and hydraulic clutches can be a tedious 2-man job. Phoenix Systems' new hydraulic bleeding kit makes the process, including bleeding ABS systems, an easy one-man proposition. Based on the Phoenix Injector, a tool that can pressure or vacuum bleed, the kit contains all fittings, adapters and lines needed to handle any vehicle. The Injector will also reverse fluid bleed—injecting fluid into the slave cylinder and forcing air out the master. The Phoenix V-10-205 bleeder kit costs $125 direct from Phoenix Systems, 3555 E. 42nd Stravenue, Tucson, AZ 85713; 888-749-7977; e-mail: phxsyss.com.

Seeing Is Believing

It seems hard to believe that you could walk into a home center and buy a tractor this substantial, but that's the case. It's powered by a 20-hp V-twin Kohler engine with cast-iron cylinder sleeves and a spin-on oil filter. Cast iron doesn't end at the engine, since the front axle is also made of this substantial, vibration-dampening material. The tractor's 50-in. mowing deck can be leveled without tools and accepts a mulching kit. The machine's transmission is a foot-operated hydrostatic unit with cruise control. It seems like a lot of tractor for $2400. It's sold at Home Depot. The same tractor, but with Briggs & Stratton's new V-twin 19-hp Intek tractor engine and a 46-in. deck, costs about $1800. Contact Scotts Power Equipment, 219 Franklin Rd., Brentwood, TN 37027; 800-646-8442.

Little Package

Who says you can't take it with you? NordicTrack's VersaLift is a full-body workout station that folds down to the size of a briefcase and weighs only 30 pounds. The VersaLift uses your body weight as resistance and 10 progressive settings allow it to provide a muscle-building workout. Eight basic exercises work the biceps, triceps, shoulders, chest, back and legs.

It sells for $149.95 at NordicTrack stores, by phone or on the Web. Contact NordicTrack, 104 Peavey Rd., Chaska, MN 55318; 800-440-2608; www.nordictrack.com.

Photo Warehouse

In accordance with Iomega's well-known removable storage devices such as the Zip drive, the company's new Clik! drive holds tons of digital information such as photos, maps or data. Want to save photos from a digital camera, download maps into a GPS device or transfer data from a PDA? Clik! seems to be a capable product for the future of convergence. It stores 40MB of information and uses a removable disk about half the size of a credit card. These disks will cost about $9.95 each. Clik! costs about $199.95 and can be found anywhere other Iomega products are sold. Contact Iomega Corp., 1821 W. Iomega Way, Roy, UT 84067; 801/778-3347.

Flat Out

Run-flat tires are not new, but run-flat tires that fit minivans are. Michelin's X-One ZP (zero pressure) tire, available in 225/60R16, 215/65R15 and 215/65R16 sizes, can travel safely for 50 miles at 55 mph, or up to 200 miles in city driving conditions, with zero air pressure. The tire's specially reinforced sidewall supports the full weight of the vehicle and passengers. The special bead keeps the tire on the rim for excellent control even under panic braking and evasive maneuvers. The all-season X-One ZP also offers outstanding wet traction, comfortable ride and high mileage, and is backed by a 6-year unlimited-mileage tread-life warranty. The tires are available through Michelin dealers and range in price from about $90 to $165 each. Contact Michelin North America Inc., Box 19001, Greenville, SC 29602-9001; 888-MICHELIN.

Great Stuff

Green Alternative

More than 3500 golf courses have banned metal spikes, and it won't be long before the rest of them do. Softspikes has unveiled a new line of alternative cleats that incorporate many benefits of the bygone metal spikes.

The Softspikes XP-M cleats feature a zinc-coated metal thread that's easier to install and won't screw out. The zinc coating also seals out water. On the business end, each spike has eight plastic mini-nubs positioned around the perimeter and angled outward for traction.

Available for golf shoes with standard cleat receptacles, a package of Softspikes XP-M can be purchased at sporting goods stores and golf shops for $9.95. Contact Softspikes, 1901 Research Blvd., Suite 350, Rockville, MD 20850; 800-638-0075.

Cranium Coddler

The Shoei X-sp delivers safety and comfort. Combining light weight with full features, the helmet's Dual Liner Ventilation system is said to be the most advanced on the market. Low-pressure vents in the air intake system reduce or eliminate fogging. The 52-ounce aerodynamically designed helmet is Snell M-95 and DOT-approved. The flush face shield reduces wind noise, comes with a scratch-resistant coating and protects against UV rays. The helmet costs $582.99 at motorcycle accessories outlets. Contact Shoei Safety Helmet Corp., 22605 E. La Palma Ave., Suite 507, Yorba Linda, CA 92687; 714/692-8776.

The Big Three

This blower has three characteristics that make it worth considering if you're shopping for outdoor power tools. First, it's light—it weighs 7 pounds. Second, it's reasonably quiet at 68 dBA. Finally, it's inexpensive—it costs about $80. Its manufacturer says that its 18cc engine helps the machine move 350 cfm of air at 150 mph, certainly enough for all but the most matted leaves. A couple of other nice features on the machine are its horizontally configured impeller, which makes it easier to handle than many blowers with vertical impellers, and the machine's translucent gas tank, which makes it easier to see the gas level. It's sold at hardware stores and home centers. Contact Poulan/Weed Eater, 5020 Flournoy-Lucas Rd., Shreveport, LA 71129.

Sure Bet

A cookout shouldn't be a casino-like experience: Will the grill light? Does it have fuel? Will the grill cook the food or incinerate it? If your gambling days are over, then perhaps you should consider Weber's Platinum Series II grills. Each of the three products in the line is designed with maximum reliability and convenience in mind. Their burners are made from durable stainless steel. Metal work surfaces are coated with porcelain for weather and wear resistance. A gas gauge provides an accurate reading on the amount of fuel. Each of the grills has a minimum cooking area of 611 sq. in. and a minimum gas input rating of 36,000 BTUs per hour—enough capacity for large cookouts. The grills range in price from $1100 to $1500. Shown is the midlevel 3200 grill, with a 14,000-BTU side burner. It costs about $1300. The grills are sold at Weber dealers. Contact the company at 200 E. Daniels Rd., Palatine, IL 60067; 800-474-5568.

Light Of Your Life

For a cool rechargeable flashlight, look to RKS Design's Dash-Light, easily recharged in a car's cigarette lighter. The Dash-Light is easy to handle and has a battery integrated into the part that slides in and out of the car's cigarette lighter. The light sells for $13 at consumer electronics stores. Contact RKS Design, 350 Conejo Ridge Ave., Thousand Oaks, CA 91361; 805/370-1200.

(More New Products on page 58)

With his taste and good looks, Vasco da Gama is welcome everywhere.

Introducing Vasco da Gama. Premium tobaccos, aromatic cedar sleeves, and a surprisingly affordable price make this fine cigar a pleasurable addition. Anytime. Any place. Enjoy the light claro wrapper or the milder, dark maduro version.

VASCO DA GAMA™

Always welcome. Everywhere.

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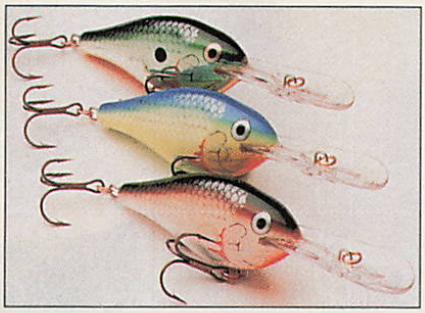
Great Stuff

(Continued from page 56)

It's A Rap

Before the Risto Rap lure was even introduced, it won the $1 million Minnesota FLW Bass Tournament. Like all of Rapala's hard baits, it features a hand-crafted, tank-tested balsa body. It comes in two different sizes and eight color patterns. A large plastic lip provides a variety of movements.



The Risto Rap is available at Wal-Mart, Bass Pro Shops or outdoor retailers for $5.95. Contact Normark, 10395 Yellow Circle Dr., Minnetonka, MN 55343; 612/933-7060.

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Automatically lowers when door opens
Automatically retracts when door closes for maximum clearance
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AUTOMATIC VEHICLE STEP
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With their greater curb height, simply getting in and out of today's pickups and sport utilities for some family members can be a real chore. But with the Kodiak SideWinder™ Automatic Vehicle Step that's no longer the case.
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If Tires Could Talk

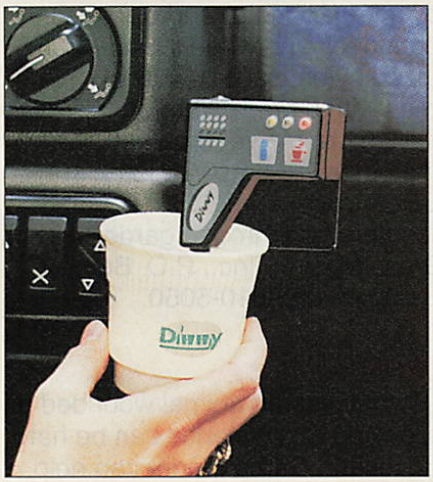
Some cars now talk, but tires still can't. If they could, they would tell you their air pressure. SmarTire comes close. This wireless pressure monitor system uses a sensor on each wheel to continuously monitor the pressure and temperature of each tire. The information is transmitted to a display monitor that's mounted inside the vehicle on the dash or visor. SmarTire's suggested retail price is $399. For retail locations, contact SmarTire USA Inc., 200 E. Bluegrass Dr., Norwalk, OH 44857; 888-982-3001.

Downsized Digicam

Panasonic's new PV-DC1080 PalmCam digital camera is touted as the smallest digital camera with an LCD panel and removable memory. It has a CompactFlash memory that stores up to 2MB of information or up to 85 digital images. It also has an optical viewfinder, detachable electronic flash and 2x zoom. Up to 85 pictures can be stored with a resolution of 320 × 240 pixels or 24 fine-resolution shots of 640 × 480 pixels. The camera costs $499.95 at consumer electronics and photography stores. Contact Panasonic, One Panasonic Way, Secaucus, NJ 07094; 201/348-7182.

Coffee, Tea Or Cream Of Mushroom?

Give your cup holders something really tasty to grab hold of. Here's an automatic hot drink dispenser that uses cups prefilled with an instant beverage of your choice, a reservoir of bottled water and a dash-mounted dispenser. Push the ON button and water is heated to 150°F. Hold your cup under the spout and it's filled automatically. Water flow stops when you remove the cup. The system will fit any car and will give you a convenience item that you can lord over the Lexus crowd. The Diwwy costs $200 from Design Tech International Inc., 7955 Cameron Brown Ct., Springfield, VA 22153; 703/866-2000.



Flash Reader

The SanDisk ImageMate is an external device that attaches to a PC parallel port and allows consumers to download images from a digital camera up to 20 times faster than they could using a serial port connection. You can also move data and audio captured on a CompactFlash card from a handheld computer or audio recorder straight to a PC. This gadget costs $99. Contact SanDisk, 140 Caspian Ct., Sunnyvale, CA 94089; 408/542-0503.

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Originally developed for precision cleaning in the high-tech plastics industry, XENIT is powerful yet harmless to most surfaces when used as directed. It drys completely, leaves no messy residue, and has a pleasant orange scent. It even contains a disinfectant to help kill germs and odors.

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Great Stuff

Lumbering Along

Powered by a 6.8-hp chain saw engine, the Jonsered 6000 sawmill can handle logs up to 27½ in. in diameter. The basic mill consists of steel rails about 39 in. long that are positioned on lumber lying on the ground. You roll the log up onto the rails and hold it in place with cam-operated log locks. Set the saw cutting height by turning the crank atop the saw carriage. The band saw head rides up and down on a pair of screws and is guided by a pair of steel bars. Squeeze the throttle control and push the saw carriage through the log. The mill is capable of producing anything from veneer stock slightly less than 3/32 in. thick to beams measuring 20 × 24 in. The mill costs about $5500 at Jonsered dealers. Contact Tilton Equipment Co., P.O. Box 68, Rye, NH 03870; 800-447-1152.

Puppy Love

We couldn't think of a better name for this mower than the one it has: LawnPup. This friendly little pooch is powered by a 9-amp motor and weighs only 22 pounds, thanks to a deck and wheels made from plastic and a rubberized nylon blade. It cuts a 13-in.-wide swath and comes with a grass catcher. It is fully height-adjustable. If it's more mower than you can handle, you can get a petite 7.2-amp version that cuts a 12-in. swath. Both cost about $150 at hardware stores, home centers and through gardening catalogs. Contact Grass Masters Inc., P.O. Box 3285, Barrington, IL 60011; 888-810-5050.

You Don't Say?

Most politicians probably hope products like this never hit the market, but for anyone who needs to record telephone conversations, the new Record-A-Call is heaven-sent. Plug this phone accessory into an ordinary telephone to replace the existing handset and record any conversation at the touch of a button. The product, produced by New York-based Record-A-Phone Corp., features a modular telephone jack that connects to any telephone base. It includes a built-in tape recorder using microcassettes in 30-, 60- or 90-minute lengths. To double tape capacity, check out the Long-Play feature, which lets you record up to 180 minutes. You'll find this neat item at small office/home office stores for $79.95. Contact Record-A-Phone, 35 Essex St., New York, NY 10002; 212/674-5436.

You Got Game

Sometimes an animal wounded or downed at a distance can be hard to locate. Game Finder can help.

The device uses infrared technology to detect temperature differences as slight as 1°F. With a range of up to 1000 yards, these thermal detection units use an LED display to help you home in on downed game. A squelch mechanism allows you to adjust for conditions.

The three units address various hunting needs and range from $124 to $324. They're available at hunting stores or through specialty catalogs. Contact Bonner Technologies Group, 2007 Bob Wallace Ave., Huntsville, AL 35805; 800-459-3463.

(More New Products on page 64)

The 1953 Good Humor® Truck

Officially authorized by Good Humor!

Shown approximately actual size (Scale 1:24; 8¼" in length).

Expertly crafted of die-cast metal from over 175 parts!

The Good Humor Company has been putting smiles on the faces of American kids for more than 75 years. In the innocent, joyful years of the 1950's, the Good Humor truck was an everyday sight in many American communities. Kids would always come running when they heard the sweet-sounding "Ring-a-ling-a-ling" bells of a Good Humor truck!

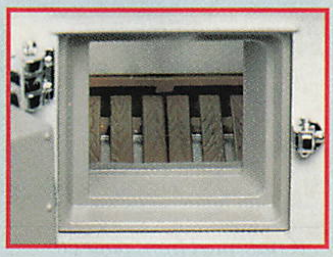
Whether your favorite Good Humor treat was Toasted Almond on a stick, a scrumptious sundae or any of the other frosty delights, you will bring back a flood of wonderful memories when you acquire the *1953 Good Humor Truck.*

Meticulously crafted.

This beautiful replica is crafted in large 1:24 scale from more than 175 precision parts. You'll be delighted at the authentic detail. The gleaming chrome grille, the tiny jewel-like taillights, and all the fascinating and colorful advertising on the original 1953 truck have been accurately reproduced on this replica. Expertly painted and hand-waxed, your *1953 Good Humor Truck* will be the pride of your home or office.

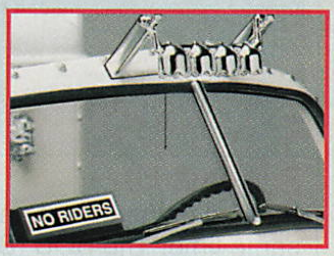
Attractively priced.

It cost over $300,000 to develop the *1953 Good Humor Truck.* However, you can own it for only $129, payable in five convenient monthly installments of just $25.80 (plus any applicable sales tax and $1.20 shipping and handling per installment). Mail your Reservation Application today!



The rear door opens to reveal the beautifully replicated storage compartment with its simulated wooden pallet.

Even the ice cream menu is authentically reproduced – right down to the actual 1953 prices!



Authentic details include "NO RIDERS" sign and chrome bells mounted above the windshield.

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The Danbury Mint
47 Richards Avenue
Norwalk, CT 06857

THE 1953 GOOD HUMOR® TRUCK

Yes! Reserve my *1953 Good Humor Truck* as described in this announcement. If not completely satisfied, I may return my replica within 30 days for replacement or refund.

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Send no money now.

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(Please print clearly.)

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City _____ State _____ Zip _____

Signature _____
(Orders subject to acceptance.)

Allow 4 to 8 weeks after initial payment for shipment.

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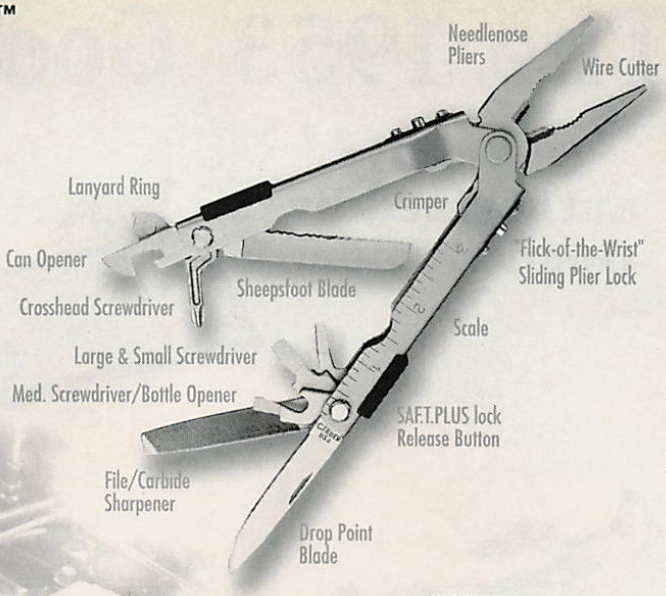
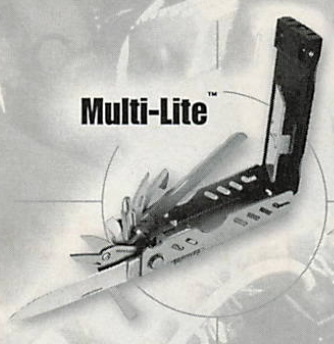
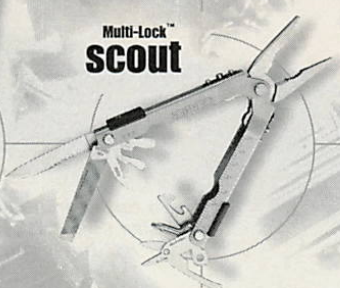




Emergency Light & Fiskars® Scissors



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1 Handed Opening & ATS-34 Blade

PROUDLY MADE IN USA

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Portland, OR 97223
Attn: Cust. Service - PM

(Continued from page 60)

Bottoms Up

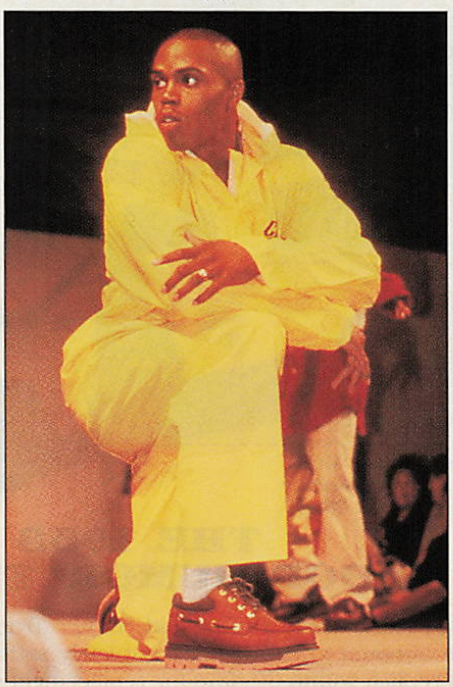
Be kind to the planet and save a few bucks at the same time. The BOB (Bottom of the Bottle) oil recovery system lets you drain that last hard-to-get ounce or so of oil that usually remains in the plastic quart bottle of new motor oil after you pour the contents into your engine.

Instead of just polluting landfills, the oil recovery system allows you to drain the dregs of five 1-quart bottles into another bottle. BOB mounts to a wall or tabletop and costs less than 10 bucks from Auto Accessories of America, Route 322, Box 427, Boalsburg, PA 16827; 800-458-3475.

Cat's Paws

For years Caterpillar has been building sturdy diesel engines for commercial and recreational boaters. Now, the company is offering a line of marine footwear that is made to be equally tough.

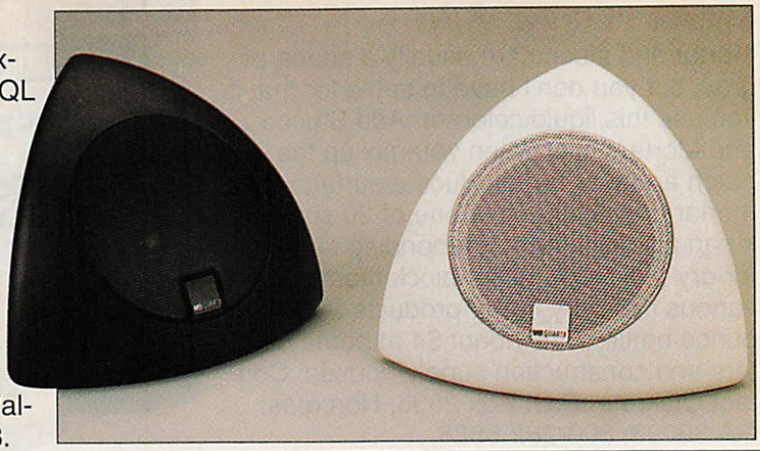
Caterpillar Marine Footwear comes in seven different styles, all with the Caterpillar logo embossed on the heel. All the shoes have a patterned rubber outsole for traction, and leather uppers that are both attractive and protective. Some have a mesh lining that cushions the foot while keeping it dry.



The shoes are available at various retail stores, including JC Penny and Track-n-Trail, and range in price from $72 to $112. Contact Caterpillar, 9341 Courtland Dr., Rockford, MI 49351; 616/866-5500.

Great Stuff

Sound Design



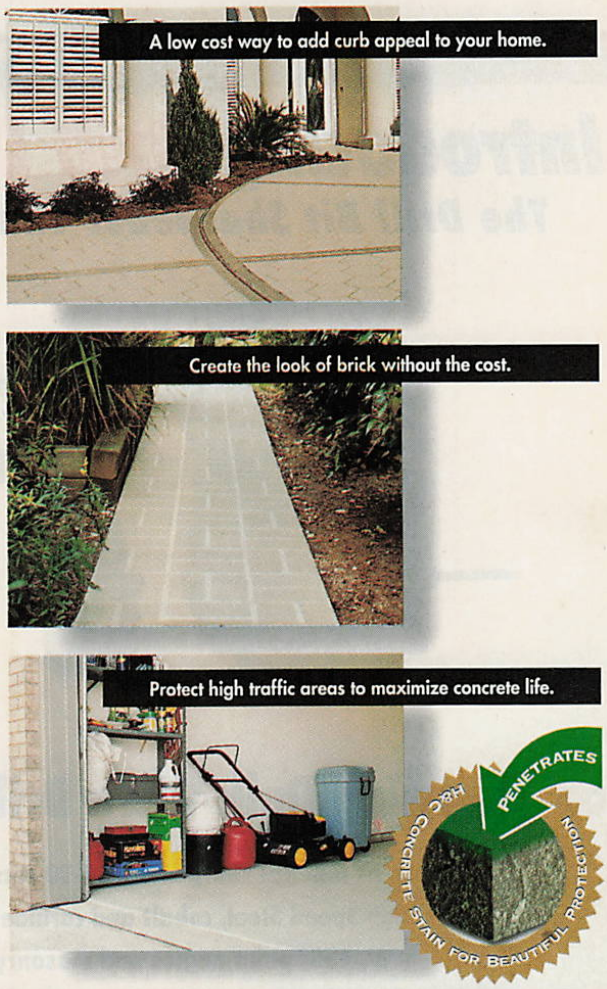
MB Quartz's new tiny loudspeaker is built with extreme flexibility and mobility in mind. The OCTA QL A40 is a subcompact speaker made for whole-house audio systems. These speakers measure just over 5 in. in every dimension. The speakers can be fit together to create a different sound for any situation. They work well with larger audio systems, but can also perform with shelf systems or a low-powered stereo receiver. And the smaller the speaker, the easier it matches the decor of any room. A pair of these little marvels costs $99. Contact MB Quartz Electronics, 25 Walpole Park S., Walpole, MA 02081; 508/668-8973.

Hedge Your Bets

Tall and wide hedges require tools to suit them—otherwise your hedge trimming is liable to take all day. Makita's UH6330 is a 5-amp trimmer with blades nearly 25 in. long, and it weighs only about 7 pounds. The blades move at 1500 rpm. As a safety feature, the trimmer has an oversize switch in both handles. If your hands are not on both handles, it won't run. It costs about $285 at hardware stores and home centers. Contact Makita USA Inc., 14930 Northam St., La Mirada, CA 90638.

Long And Shorts Of It

Tracking down electrical shorts can be a pain. The FaultFinder makes the job of tracing wires and locating shorts, open connections, broken wires and current leaks less of a hassle. Simply hook up the transmitter in series with the circuit and scan the circuit or wire with the tracer's flexible probe. No contact with the wire is necessary. Audio/visual signals home in on the location of the fault. The tool works on 6- to 36-volt systems. It's available at auto parts outlets for less than $200. Contact Sheffield Research, 257 Harbour Ave., N. Vancouver, BC, Canada V7J 2E8; 800-440-5582.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Great Stuff

Shades Of Gray

Mortar and stucco are usually a shade of gray, but you don't have to settle for that if you use this liquid colorant. Add Stucco and Mortar Color when you mix up the batch and you can produce a surface with mortar or stucco in any one of 20 shades. It can also color surface-bonding cement for dry-laid block, glass-block mortar and various masonry repair products. A 10-ounce bottle costs about $4 at home centers and construction supply houses. Contact Quikrete, P.O. Box 2836, Norcross, GA 30093; 800-282-5828.

Combo Vest

Although sportsmen have only one body, they usually have two vests they want to wear. One is a trusty hunting or fishing vest that doesn't inhibit movement and has lots of pockets for extra gear. And the other is a personal flotation device that could save their lives.

Now the Stearns Inflatable Sportsman's Vest brings the two together. When deflated, the roomy vest has six pockets and a removable lure patch. Pull the cord and an enclosed CO_2 cartridge inflates the vest, providing 22.5 pounds of buoyancy. Coast Guard-approved as a Type III flotation device, the vest has a waist belt for a snug fit and comes in four colors, including camo. You can find it at marine, hunting and outdoor stores for around $100. Contact Stearns, 1100 Stearns Dr., Sauk Rapids, MN 56379; 800-697-5801; fax: 320/252-4425.

Fun For Sail

Precious few sailboats can entertain both novice and expert alike, but the Escape 9 is one.

The durable polyethylene hull weighs only 85 pounds, which makes it fast and exciting. Yet the 4-ft. beam and lightweight carbon-fiber mast make it very hard to tip over. If you pick up too much speed for comfort, just roll up the easily adjustable sail to slow down. A patented deck-mount system keeps the boom above headache-inducing level. The Escape 9 costs about $1800. Contact Escape, 200 Highpoint Ave., Portsmouth, RI 02871; 800-SAIL-ONE; fax: 401/683-9640. PM

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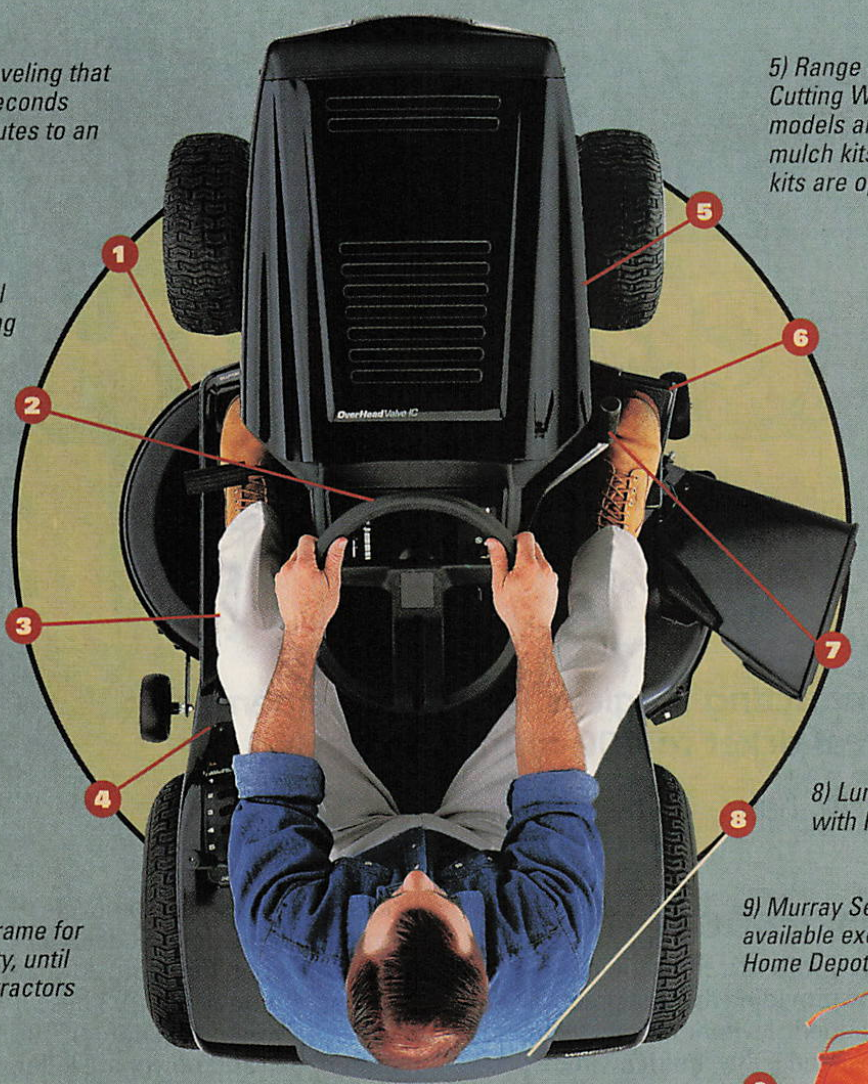

5) Range of Horsepower and Cutting Widths available. All models are fully equipped with mulch kits installed, bagging kits are optional.

6) PedalTouch™ AutomaticDrive™ Transmission for control of both forward and reverse speeds without shifting or clutching.

7) Easy-To-Reach Controls located out of kneecap range for increased legroom.

8) Lumbar Support Seat with Fingertip Adjustment.

9) Murray Select is available exclusively at Home Depot.

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MURRAY SELECT

TRACK TO THE FUTURE

Forget superconducting maglevs. The humble permanent magnet is the real ticket to 400-mph train travel.

BY SCOTT R. GOURLEY; Illustration by Jeff Mangiat

TRANSPORTATION

Simple permanent magnets like those you played with as a child could usher in a new era in railroading by providing the first practical and inexpensive maglev (magnetic levitation) train technology. Researchers Dick Post and J. Ray Smith invited POPULAR MECHANICS to the Lawrence Livermore National Laboratory (LLNL) for an exclusive first look at this radically new concept. Called Inductrack, it is the first levitated train to use passive permanent magnets. That's right, permanent magnets. Big brothers—really big brothers—of the ones that hold your kid's artwork on the refrigerator.

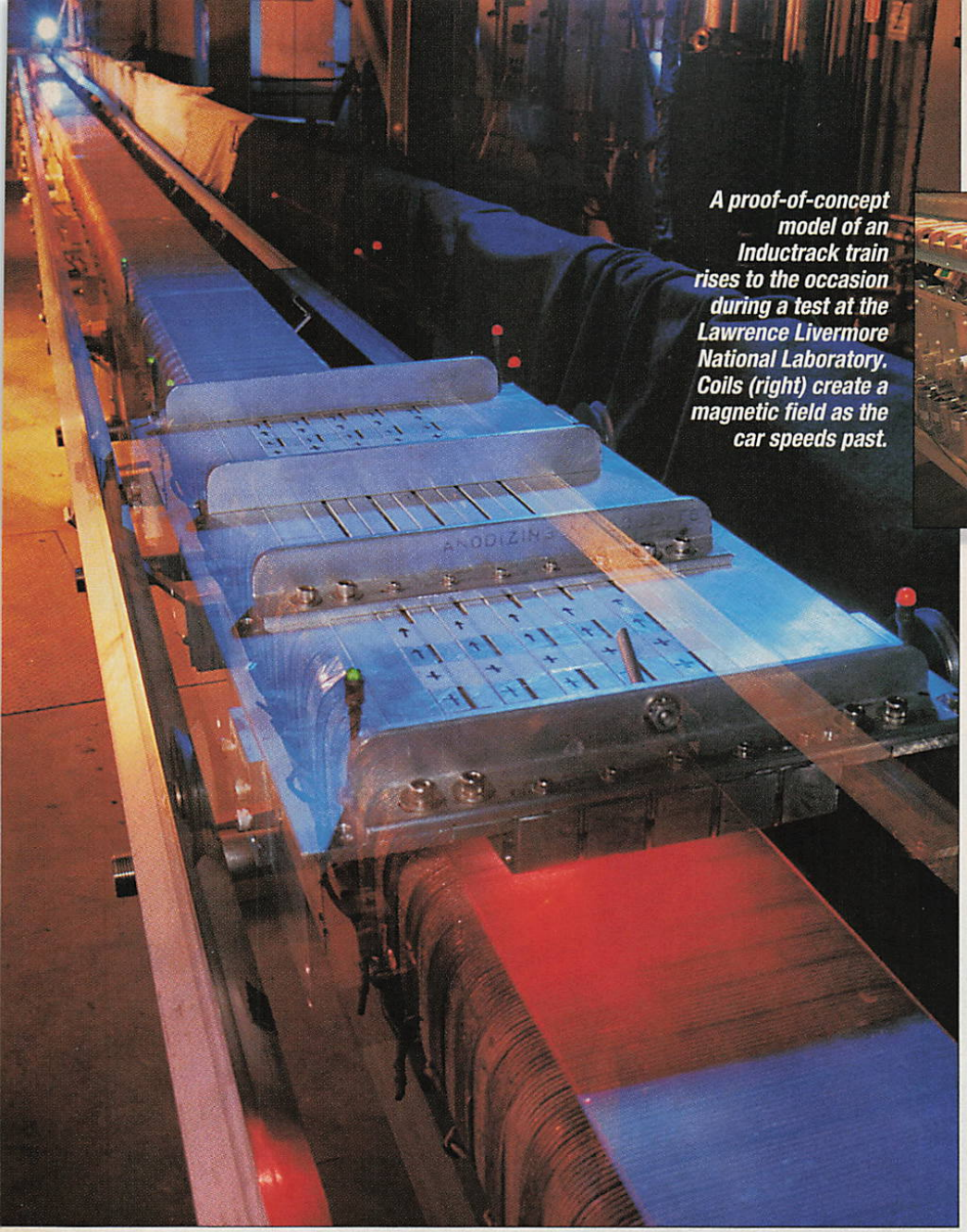
PM followed Post and Smith to their sub-basement laboratory—once used for radiation experiments—where they have assembled the first proof-of-concept prototype. "The transition speed, which is the point where the magnetic lifting forces of the train really begin to take off, can be as little as about one mile per hour," Post says as he walks across the floor at a slow, measured pace. "And I'm walking at twice that speed right now." It is a speed that promises to change railroading as dramatically as the switch from steam locomotives to diesel engines.

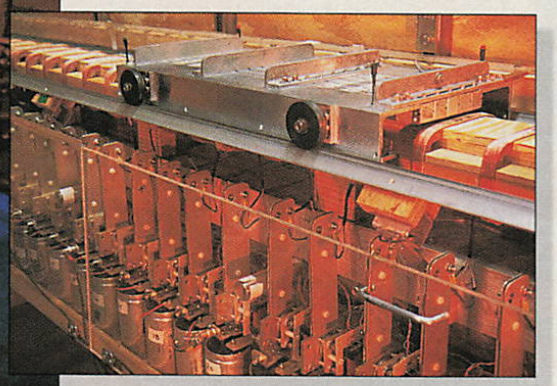
Maglevs are, of course, old news. Prototypes have been in various stages of development in the United States, Germany and Japan for about 20 years (see diagram on page 70). These prototypes work well enough, but maintenance and power are killers—they require too much of both. The problem is not the engineering, but the underlying approach to levitation. Up to now, maglevs have fallen into two general categories, says Smith. One type uses superconducting magnets that lift the vehicle to within a fraction of an inch of a rail guide. Keeping the train airborne and in motion requires accurate feedback circuits and very high tolerances. Post explains that this design tends to be somewhat unstable. "It can be done, but it's expensive and difficult," he says. The other generic type of maglev takes superconducting coils and runs their magnetic field past a conductive plate to achieve levitation force. Inductrack has some similarities, but its inventors stress that it has higher lifting efficiency relative to the drag forces.

Inductrack's other big advan-

The Inductrack system could be retrofitted to existing railways. Power would be provided by overhead wiring or, as shown here, on-board diesel generators.

Popular
Mechanics
MAY 1998





A proof-of-concept model of an Inductrack train rises to the occasion during a test at the Lawrence Livermore National Laboratory. Coils (right) create a magnetic field as the car speeds past.

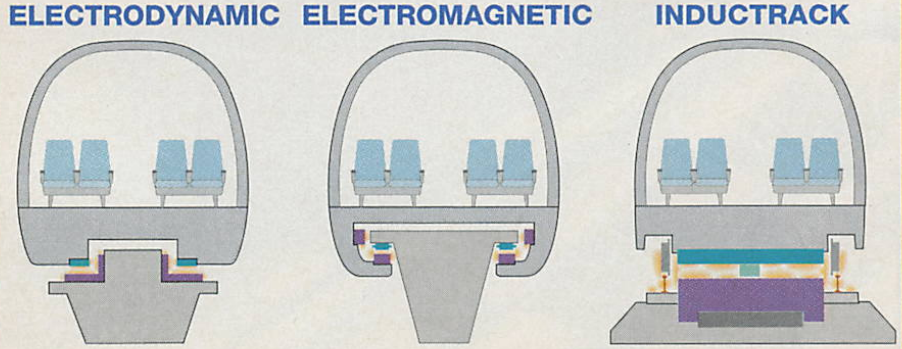
tage is that it eliminates superconducting coils and their attendant ultralow temperature cooling systems, which are very expensive to operate. Inductrack is simplicity itself. It consists of unpowered, passive magnet arrays attached under a vehicle, and a track guideway with metallic, nonmagnetic inductive coils embedded in its surface. The train rests on auxiliary wheels when it is stopped. Ordinary train motors bring it to a speed approximating a brisk walk. At this point, the magnets and inductive coils repel each other. The train begins to float. Energized coils make the track function like a linear motor, providing both acceleration and braking—the latter by flowing energy back into the mains, or, say, into batteries or flywheels. If the drive power fails, the Inductrack system is fail-safe: It would merely slow down and settle back a few inches on its wheels at a low speed.

Obviously you can't levitate a train with just any magnet. Inductrack uses a permanent magnet design known as a Halbach array. These arrays were pioneered by physicist Klaus Halbach for use in particle accelerators. The uniquely efficient arrays of permanent magnet materials concentrate the magnetic field on one face of the array, while nearly canceling it on the opposite side.

When mounted on a moving cradle—say, the bottom of a railcar—and passed over passive coils on a rail track, the Halbach arrays generate a periodically varying magnetic field that induces currents in the closely packed track circuits. When made from modern permanent magnet materials, 50 pounds of load can be lifted with 1 pound of magnet. "That's far better lifting force with much less drag than the ones that use superconducting coils and a plate of conducting material," says Post. He points out that at high speeds the Inductrack has up to 10 times the lift force relative to its electromagnetic drag force compared to the lift of a modern jet aircraft wing relative to its aerodynamic drag force.

In addition to its high performance potential, the unusual properties of the Halbach array magnetic field offer other tangible benefits for passenger train application. "That field is concentrated at the lower surface of those magnets and it's virtually zero above those magnets," explains Post. "So you don't have to

Levitation Techniques



Electromagnets on the guideway levitate the car.

Electromagnets on the cars lift the cars.

Permanent magnets levitate over passive coils.

ILLUSTRATIONS BY GEORGE RETSECK; PHOTOS BY JAMES A. SUGAR

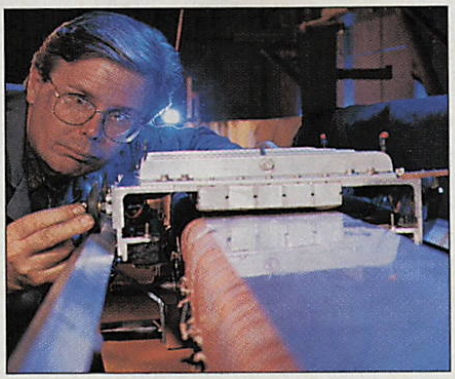
NASA may one day use Inductrack to launch vehicles into space.

worry about the passengers if they're concerned about a magnetic field at all. Whereas if you have big superconducting coils, that makes quite a magnetic field you'd have to shield your passengers against."

The proof-of-concept prototype for Inductrack consists of a 60-ft. wooden guide rail wrapped with approximately 1000 inductive wire coils. Each of the rectangular coils is about 7 in. wide × 4 in. high. They are shorted together to form a circuit with no outside electric connection. It is the passage of the cart with its Halbach arrays that induces current in the coils which then produce the levitating force.

Another advantage of Inductrack is that it can use powerplants already in use. "You can think of areas where moving trains all electrically makes the most sense, like the BART [Bay Area Rapid Transit] trains," Smith said. "You would certainly do those electrically. But if you were going cross country on a high-speed system, maybe the initial phases wouldn't be all electric. Maybe that would be magnetic levitation with the Inductrack principle, using a gas turbine to drive it."

As Bill Kent, the LLNL mechanical technician who helped build the model, prepares to "launch" a 48-pound model cart at the far end of the rail, Smith explains that the transition speed varies inversely with the size of the vehicle. For this



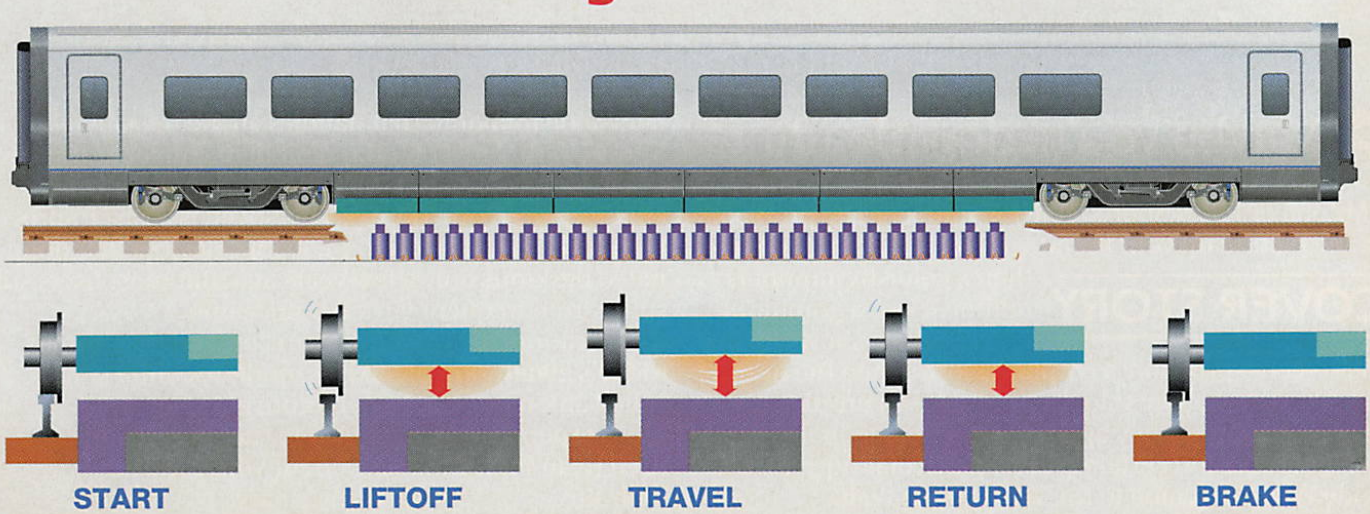
The scale model needs to achieve higher takeoff speeds than a full-size train.

reason, the proof-of-concept model needs to attain a higher transition speed than will an actual train. Magnetic levitation occurs when the vehicle reaches transition speed. At this point, the two Halbach arrays on the bottom of the car provide levitation and one on each side create lateral stability.

The demonstration confirms what the calculations have already predicted. Before transition speed is reached, the electromagnetic currents are out of phase, resulting in considerable drag on the vehicle. This drag becomes apparent when the car is pushed by hand. Pushed slowly, it rolls freely on its wheels. Pushed faster, the currents begin to create drag. Below the transition speed, the harder the push, the greater the drag, while above the transition speed, the opposite holds: The higher the speed, the lower the electromagnetic drag force. The lab model needs to reach about 22 mph before it transitions off its wheels and levitates. Post believes an actual train could transition at speeds as low as 1 to 2 mph. To get its model moving fast enough, the LLNL team has rigged up a 3:1 pulley system energized by the gravitation tug on a bucket of bricks dropped from the main floor. "Archimedes would have been proud," Smith jokes.

Since PM visited the lab, the researchers have replaced the gravity drive with an electromagnetic drive using condensers and pulsed drive coils. The laboratory and the Department of Energy were sufficiently impressed by Inductrack to invest about $500,000 in the project over the past three years. Smith and Post are currently awaiting word on followup funding that would enable them to collect data for planning a commercial-scale system. In the meantime, their novel approach to maglev has caught the eye of a government agency not known for its interest in railroading: NASA. The space agency has given the researchers a $1.5 million contract to build a model high-speed Inductrack. The idea is that NASA would use a scaled-up version to help launch satellites. The tracks would run up a ramp, accelerating a rocket to near Mach 1 before its main engines fired. Post and Smith say this application is well within the limits of Inductrack, making it truly a track to the future. **PM**

Traveling *Over* The Rails



The car rides on wheels until it reaches liftoff speed between 1 and 2 mph. After liftoff there is a brief period of vibration as the magnetic field stabilizes. The ride quickly smooths and the train and track operate like a linear motor during travel braking.

ILLUSTRATION BY GEORGE RETSECK

BY JOHN GAFFNEY; Photos by Michel Tcherevkoff

Maybe you're downloading

the Daily Disney blast for the kids. Or maybe it's the PMZone or ESPN SportsZone for yourself. The problem is, the picture on your monitor looks like nothing more than a color-by-numbers outline. First, a graphic element or two shows up on the screen—probably a corporate logo. Then the headlines, text and photos slowly arrive like an unruly group of cyber-truants. They appear on the screen in no particular order, and certainly in no particular hurry. World Wide Web? Welcome to the World Wide Wait.

COVER STORY

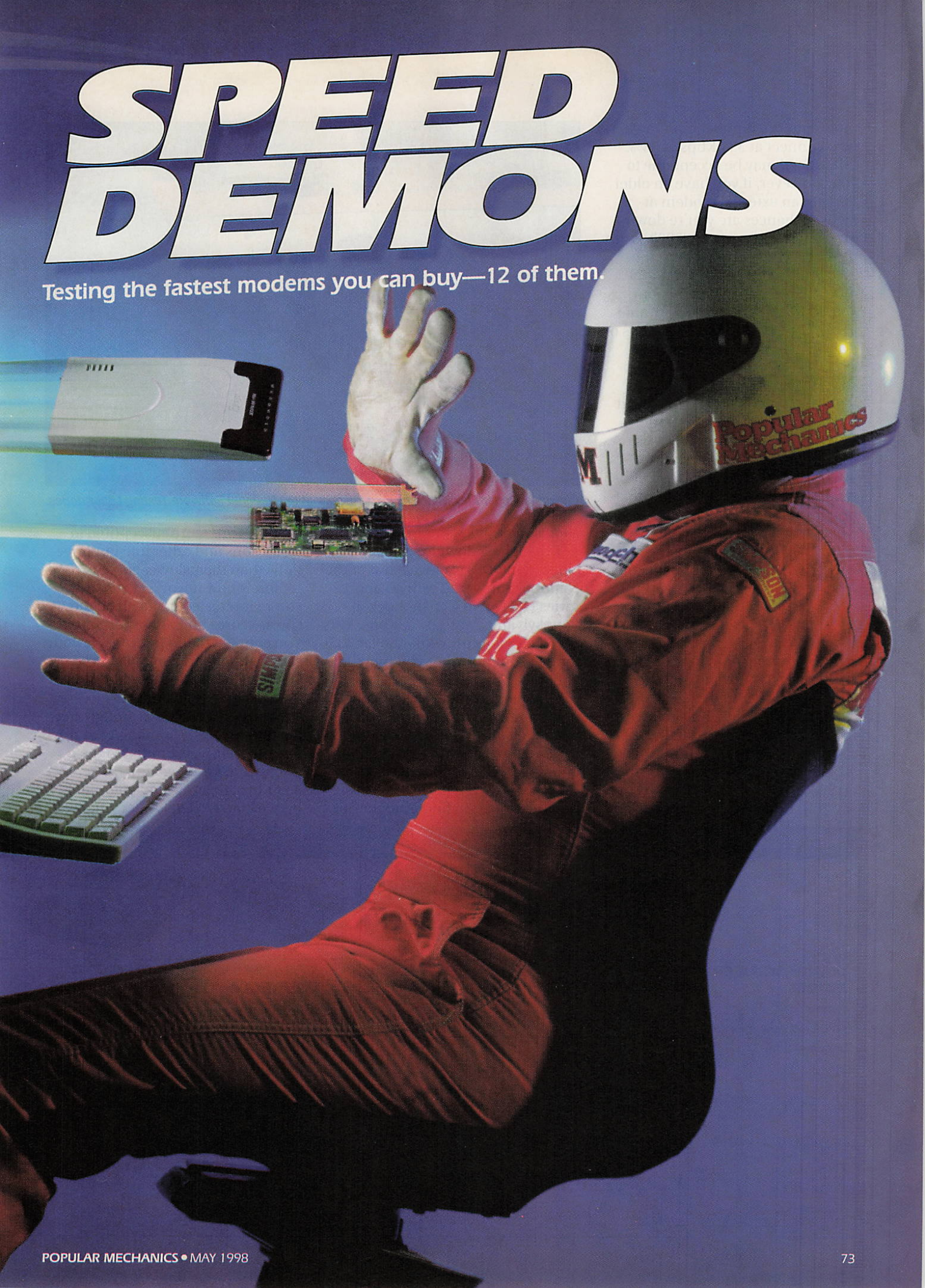
But take heart, Internet faithful. Improvement is well within reach. The problem with sending information over the Internet is that speeds are limited by your modem—the tollbooth that handles all the megabytes of information. Most of today's modems run at around 24,000 bits per second (bps), usually expressed as 28 kilobits per second (Kbps). This speed is a vast improvement over the 2400bps to 14,400bps devices that dominated desktops only a few years ago. But most users still suffer from frequent virtual traffic jams.

Liberation, if you want it, can come in the form of today's generation of 56Kbps modems, often simply called 56K modems. Faster, more complex, a bit more expensive—but a ticket to the races if you're used to an interminable wait for your favorite Web site.

The best thing a new modem will do for you is cut sharply the time it takes to download graphics-intense Web pages. Industry esti-

SPEED DEMONS

Testing the fastest modems you can buy—12 of them.

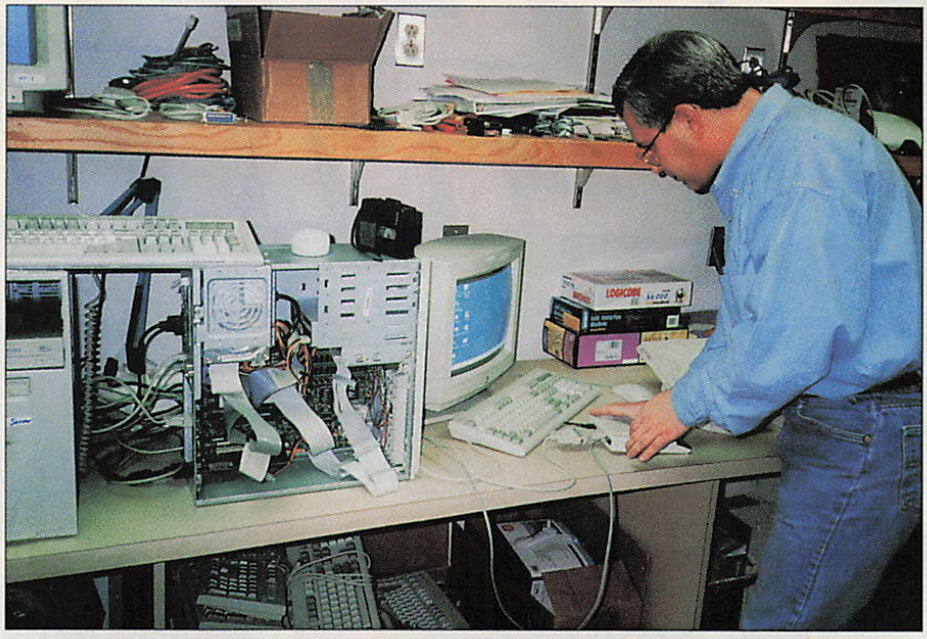


mates put the number of PC owners who connect at 33.6Kbps at 58%. That speed may be acceptable to you. However, if you have an older PC with an external modem attached, chances are you're downloading files at a rate of 9800bps at the low end and 14.4Kbps at the high end. If you have an internal modem built into a recently purchased PC, you're most likely able to receive Internet files at 24Kbps or even 28.8—which isn't bad.

Not So Fast

Unfortunately, Internet download times are also affected by your Internet service provider (ISP). As recently as one or two years ago, ISPs were overloaded by the number of requests they received for information in and out of their servers—which meant slow downloads regardless of your modem's speed. Now, if your ISP is a reputable one, it has upgraded its services. And we've seen corporate giants such as AT&T enter the game, too. So, compared to just a year ago, you're in a much better position to actually experience faster downloads when you buy a faster modem.

So let's say you decide to invest in a 56K modem—the V8 of the PC communications market. Problem is, you're really only going to run on six cylinders. While the box may say 56K, real-world downloads are a lot slower.



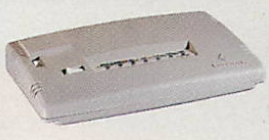
Project manager Alex Nikish checks the gear at the National Software Testing Laboratories.

The highest download speed we clocked in PM's exclusive test at the National Software Testing Laboratories (NSTL), in Conshohocken, Pennsylvania, was just 48Kbps. This is still a vast improvement over 33.6 models, but not what you thought you were buying.

Why the shortfall? The 56K tag really applies to the chip set included in the guts of these new modems. Information can move through the chip set at 56K—under perfect conditions. However, perfect conditions are tough to find. And the 56K products are more susceptible to distortions and other line imperfections than their slower cousins.

Here's how it works. Let's say you're interested in checking the sports scores on ESPN SportsZone. You connect to the Internet via your service provider. You type in the URL for SportsZone and hit ENTER. Your modem then connects to the ISP with your request, through analog phone lines. Your ability to *upload*, therefore, is limited to the phone line's analog limit of 33.6Kbps, regardless of your modem capacity. Remember, analog is

TEST RESULTS



MANUFACTURER MODEL	BESTDATA SMART ONE SERIES	BOCA	CARDINAL CONNECTA	DIAMOND SUPRA EXPRESS
Format	Kflex	Kflex	x2	Kflex
Weighted Average (bps)	46,324	43.971	N/A	30,501
Impaired Line	33,402	33,022	20,280	25,145
TP	76, 475	69,519	N/A	42,971
1:1	40,285	39,113	39,288	40,276
3:1	108,337	97,610	N/A	44,613
5:1	193,240	136,210	N/A	44,388
Time (sec.)	61.44	63.26	58.32	61.08
Fails	2	N/A	N/A	1
Clean Line	40,385	38,902	41,571	40,311
Time (sec.)	60.97	63.29	59.45	61.08
Price	$99	$140	$150	$140

You're in a much better position now to actually experience faster downloads when you buy a faster modem.

always a slower proposition.

Here's how the signal travels. On the way to the ISP, the signal stops at your telephone company's central server, where it is switched into a digital signal. It's then sent on to a digital "interswitch" telephone network, then finally to the ISP. The signal then comes back to your modem as an analog signal. This asymmetrical analog-to-digital-to-analog conversion happens for 85% of PC users' homes. If lines are multiplexed in your area, 33.6 is your top speed, so don't expect any unearthly speeds. Before you buy a 56K modem, it's important to get information on your local phone system. 3Com offers a phone line analysis at x2.usr.com/linetest1.html. Again, until analog phone lines become equipped with higher bandwidth, downloading with a typical modem isn't going to be the quickest thing around.

Will You Still Love Me When There's 64(K)?

It seems that with any PC technology, whether its microchips, operating systems or even modems, today's glamour gear is tomorrow's garbage. 56K modems are under that same pressure. A consortium of computer companies including PC king Compaq, Intel and Microsoft is working with local telephone companies to develop a new type of modem that would connect to digital subscriber lines (DSLs). DSLs are currently available only for businesses. They download and execute other kinds of communications far faster than any other technology because both connections involved, at the ISP and at the modem, are digital. They're not bound by analog bandwidth limitations.

DSL technology is nothing new. It uses existing twisted-pair copper telephone network wires. But a lack of standards and corporate cooperation have held it back for years. The united front now being presented by the Microsoft-led consortium and the big phone companies has led many experts in the field to believe DSL modems could finally appear on store shelves by Christmas. US West currently offers DSL access for a $200 installation fee and a $40-per-month charge. Compare that to roughly $150 for a 56K modem and a $19-per-month Internet connection.

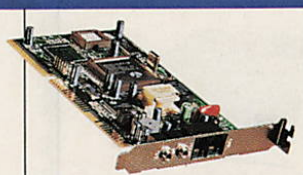
Bell Atlantic is not part of the new cooperative, according to reports, which could hang up any real DSL compatibility for quite some time. Our bet: Don't wait for cooperation in the computer industry if you're weighing whether or not to buy a 56K modem. —*J.G.*

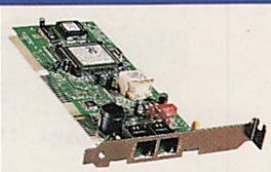
A Matter Of Protocol

Think you understand what's going on now? Well, here's another wrinkle: Since 56K modems are fairly new, manufacturers aren't yet adhering to a single standard. K56flex is a protocol, or communication code, jointly owned by Lucent and Rockwell, while x2 is owned by US Robotics (which is why the URL for the 3Com Web site starts with the characters "x2"). The International Telecommunications Union has not yet settled on official standards to unite 56K modems for universal compatibility. The two varieties share the ability to digitally encode downstream data rather than using analog modulation. 3Com claims that its x2 protocol actually widens the digital return path, and therefore enables the x2 products to grab more available bandwidth. Bottom line: The technological difference is based on microchips, and does not cause a huge difference in performance. The various tests that magazines and trade associations have run show widely varying results in terms of which technology provides a better user experience. The two protocols are not compatible, remember, so you should call your ISP to make sure it supports the modem you plan to buy before you buy it.

The PM Time Trials

It's relatively easy to proclaim a winner in the POPULAR MECHANICS





	E-TECH CYBER BULLET	GLOBAL VILLAGE TELEPORT	HAYES ACCURA	LOGICODE QUICKTEL	MOTOROLA VOICE SURFER
	Kflex	x2	Kflex	x2	Kflex
	41,636	33,506	41,230	31,070	39,726
	26,640	21,788	30,754	17,904	29,741
	76,626	60,849	65,675	61,790	63,025
	40,283	41,868	37,301	42,415	34,881
	108,200	77,149	92,235	73,418	92,010
	196,670	80.072	124,558	88,072	124,024
	60.99	58.57	63.25	57.83	73.29
	1	N/A	N/A	N/A	N/A
	39,946	42,122	34,371	41,718	36,019
	61.64	58.45	71.63	59.02	68.36
	$59	$169	$180	$130	$180

We found the eight K56flex modems turned in a better performance overall.

56K modem test. The BestData Smart One Series internal modem (K56flex) had the fastest overall performance, delivering downloads at 46.3Kbps. If you're looking for a comparison between K56flex and x2, the US Robotics Sportster external (x2) modem was a close second, clocking in at 45.1Kbps.

More than other recent testers, NSTL and PM focused on the potential difference between the two protocols. We found the eight K56flex modems turned in a better performance overall. K56flex devices averaged 39.2Kbps, versus the 34.2Kbps average achieved by the four x2 entries. Throughput testing, which measures the performance of the modem as it transfers files, showed better performance by K56flex devices. They also performed more consistently during impaired-line tests. For all the numbers, see the chart starting on page 74.

To conduct the most realistic test possible, we carefully simulated the conditions each modem would face in a standard upload/download situation. The file used in each case was about 300 kilobytes in size. The modems were each put through two tests:

1. Throughput. Each modem made a connection to a server. The file was then downloaded as an Internet file would be and the modem was disconnected upon completion. Tests were run at 1:1, 3:1 and 5:1 compression ratios, which are typical for Internet files, depending on how graphics-intense they are. For example, your favorite Web site may contain five times more information than your telephone lines can handle. Therefore, the information has to be compressed. Your modem's performance in delivering compressed files becomes important.

2. Impaired line. The throughput tests were conducted on clean lines. Impairments, or noise, were then added to the lines. This test is important because noise on the analog

How'd We Do That?

In order to test the modems properly, NSTL used an evaluation unit of the 3Com EdgeServer.

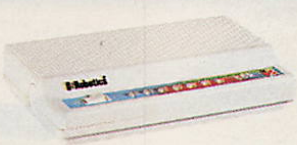
This EdgeServer is a remote-access device capable of 56K connections with modems that are x2-compatible. It falls back to V.34 (33.6Kbps) for Kflex modems, which are not compatible with the x2 products. The EdgeServer was selected because 3Com pioneered the x2 technology.

A typical edge server is a Windows NT server integrated within a remote-access concentrator. In a typical corporate setup, the applications and data that remote users need reside on the edge server.

The integration of a Windows NT server into the concentrator provides the full functionality of the server to remote users without requiring them to access the corporate LAN (local area network). An edge server provides remote users with full access to the applications and data they need while reducing traffic on the corporate LAN and increasing security by eliminating remote access to the LAN itself. At the same time, the edge server enhances performance to remote users and substantially increases input/output (I/O) throughput by avoiding the bottleneck associated with conventional piecemeal solutions or additional hops from the concentrator to the servers on the LAN. An edge server provides the following advantages:

- The ability to run any third-party Windows NT applications at the network edge in an optimized system with zero I/O bottleneck.
- The ability to add processing power (MIPS) as the number of remote-access users grows through a distributed processing architecture.
- Redundant power, hard drives, and ECC memory for maximum availability.
- Ability to be managed as a single element.
- A high-density, fault-tolerant remote-access concentrator.
- Support for industry-standard protocols with the ability to support future technologies, such as voice-over-IP and multimedia.

TEST RESULTS

			
MANUFACTURER MODEL	**PRACTICAL PERIPHERALS**	**US ROBOTICS SPORTSTER**	**ZOOM**
Format	Kflex	x2	Kflex
Weighted Average (bps)	41,313	45,148	35,434
Impaired Line	29,888	37,819	24,101
TP	67,972	62,246	61,876
1:1	39,104	43,410	40,414
3:1	93,952	77,476	83,598
5:1	126,279	81,620	81,620
Time (sec.)	64.32	64.32	61.15
Fails	N/A	N/A	N/A
Clean Line	36,599	43,193	40,337
Time (sec.)	67.27	57.00	61.04
Price	$150	$150	$130

Picking a modem isn't an easy task, especially with the literally hundreds of models on retail shelves today. In fact, some manufacturers offer two or three (or even more) different models in each speed category.

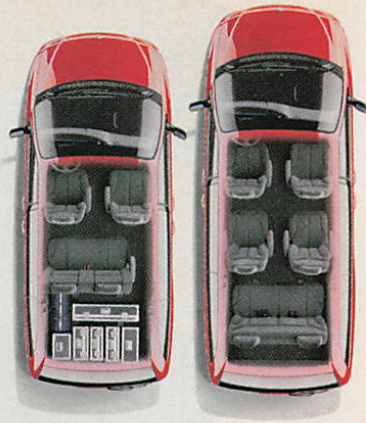
lines when you're uploading a signal to your ISP will determine your initial speed. The modem's ability to correct for this noise is crucial.

Here are more results of the test:

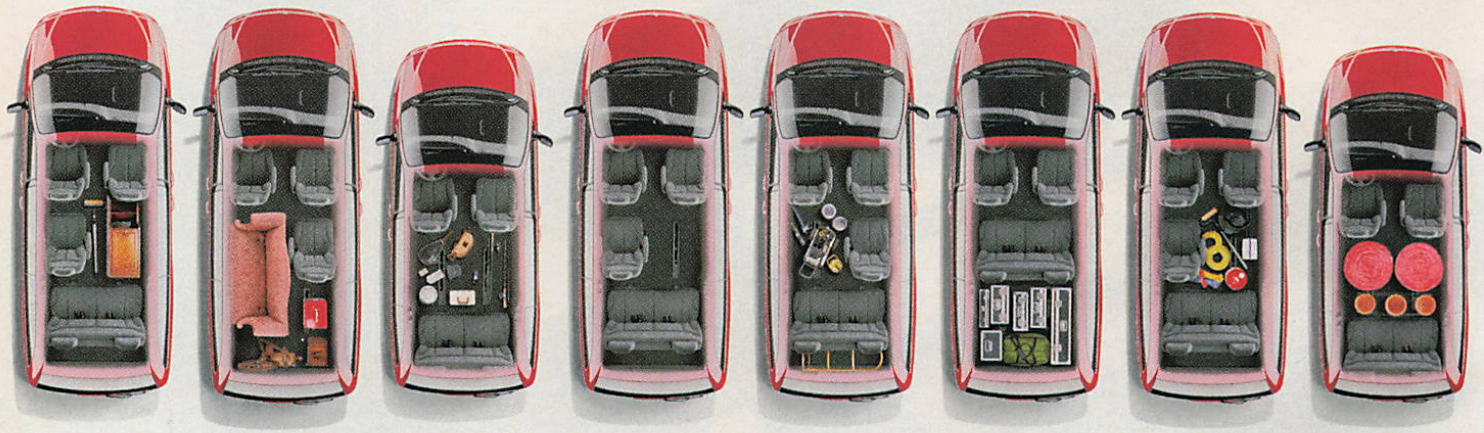
- While the x2 modems clocked an overall lower weighted average speed, their download times were actually better. For example, the best impaired-line test among the K56flex units was BestData's 60.97 seconds. The US Robotics x2 came in at 57 seconds flat. While the x2 products can occasionally be faster than their flex cousins, NSTL found flex modems to be more consistent.
- NSTL had considerable trouble with the Cardinal Connecta. It failed the throughput tests, which simply means it could not connect and was unable to download 3:1 and 5:1 compressed files. Cardinal's technical support department confirmed that the unit was set up correctly and the company was unable to provide any updated drivers or beta revisions for the Connecta.
- The Boca K56flex was the only model that came close to the BestData-series modem. It almost matched in top line speed and impaired-line testing, only to fall off considerably in the compressed file testing.
- The E-tech K56flex scored well, particularly in downloading highly compressed files, while the Hayes unit excelled in dealing with lower compression ratios, and in its weighted average.
- The US Robotics x2 was far superior to any other x2 model. It compared well, measure for measure, with most aspects of the BestData K56flex, falling behind only in transmitting files with higher compression ratios.

Regardless of the limitations, competing protocols and technologies on the horizon, 56K modems are a reasonably priced alternative to waiting for some other large corporation to improve your Internet experience through cable modems or new hyperspeed modems. With the increased usage of streamed video, Shockwave, Java applets and other more complex files, download times aren't getting any faster. So your modem better be. **PM**

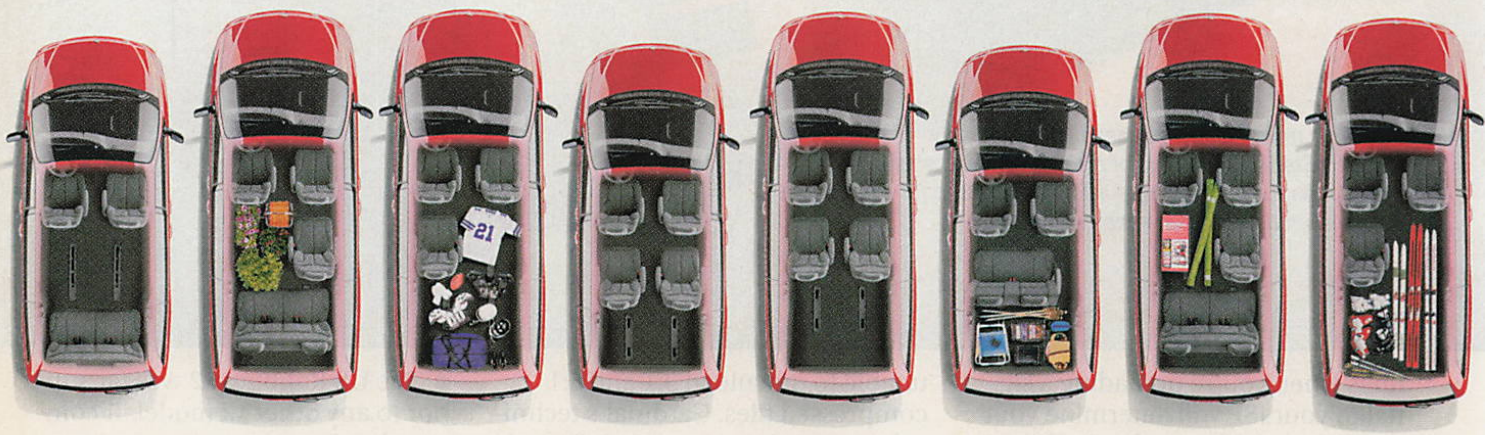
Go configure.



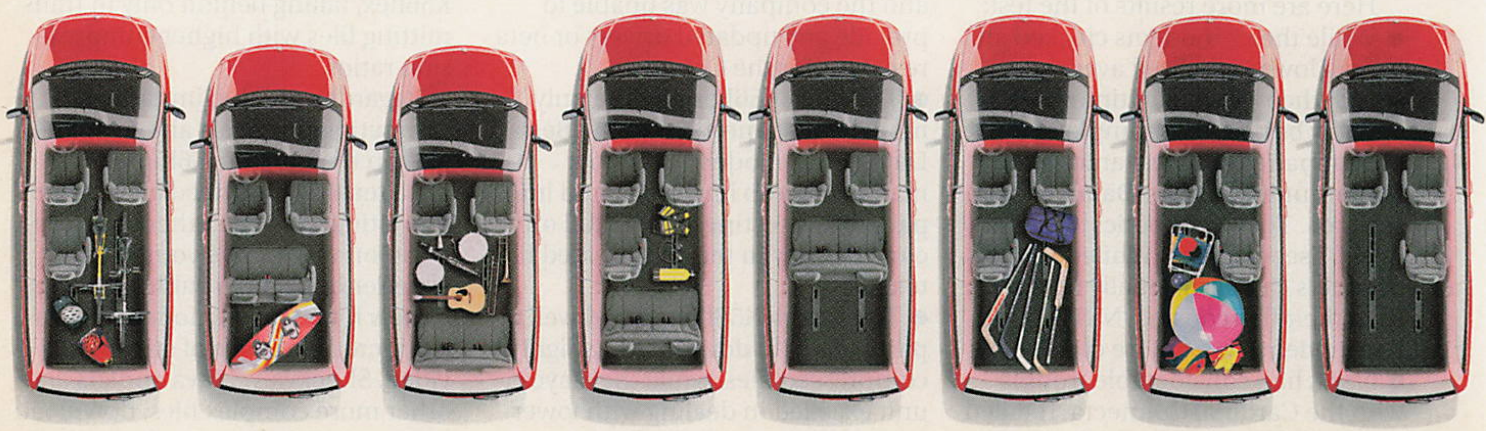
Since Caravan's Easy Out Roller Seats™ have wheels that pop down like landing



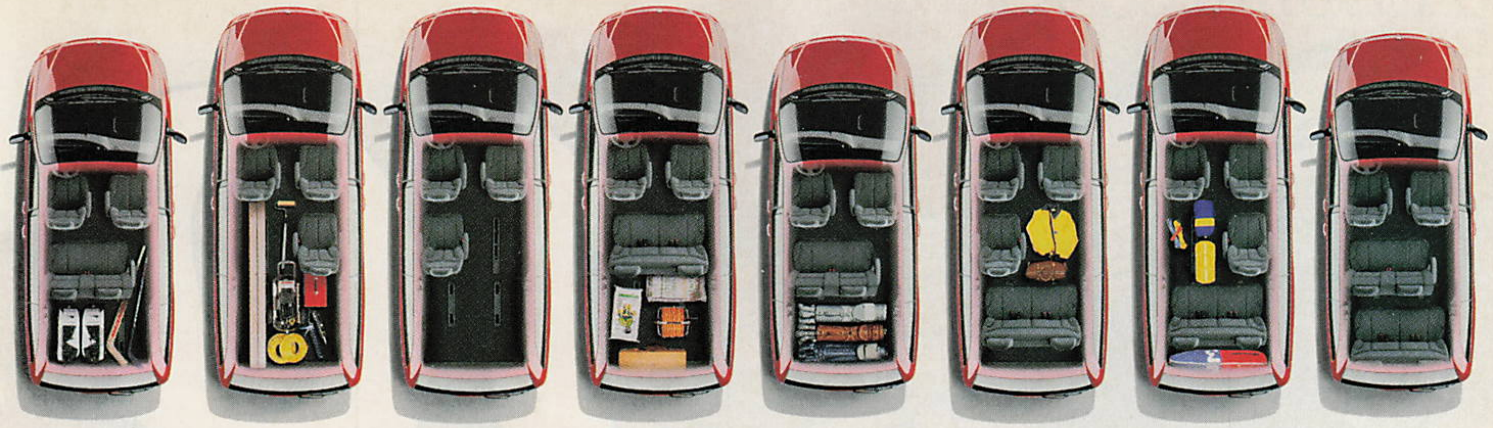
a variety of configurations is an exercise in convenience, not an exercise in...well...



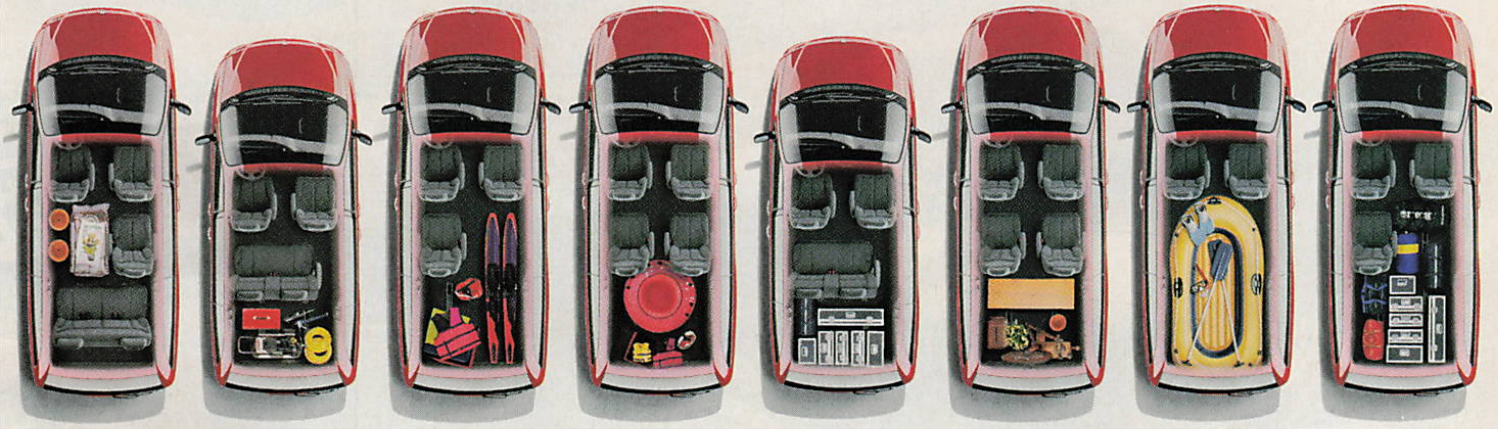
wheelbase Grand Caravan, is 37. Which we figure is just about right for your average



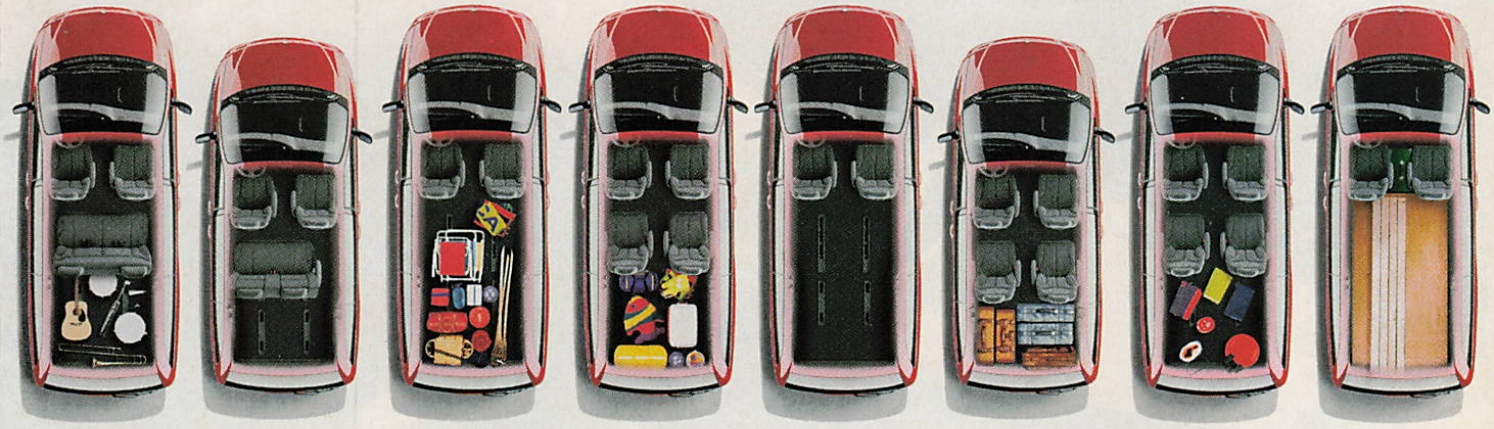
call 1-800-4-A-DODGE or roll your cursor over to: www.4adodge.com



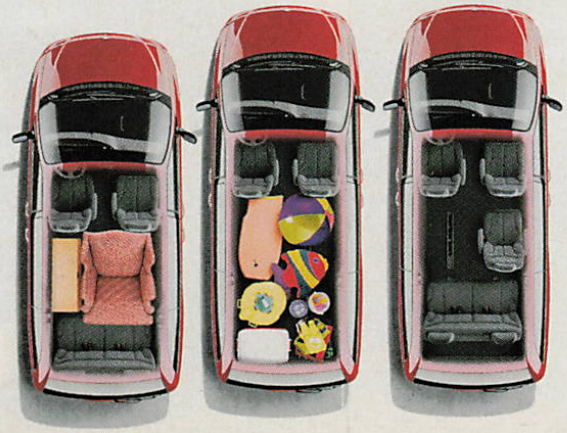
gear, rolling the benches in and out is a snap. And arranging Caravan's interior into



exercise. The total number of possible configurations in all, including the longer



Saturday. To learn more about the terrific ease and versatility of Dodge Caravan,

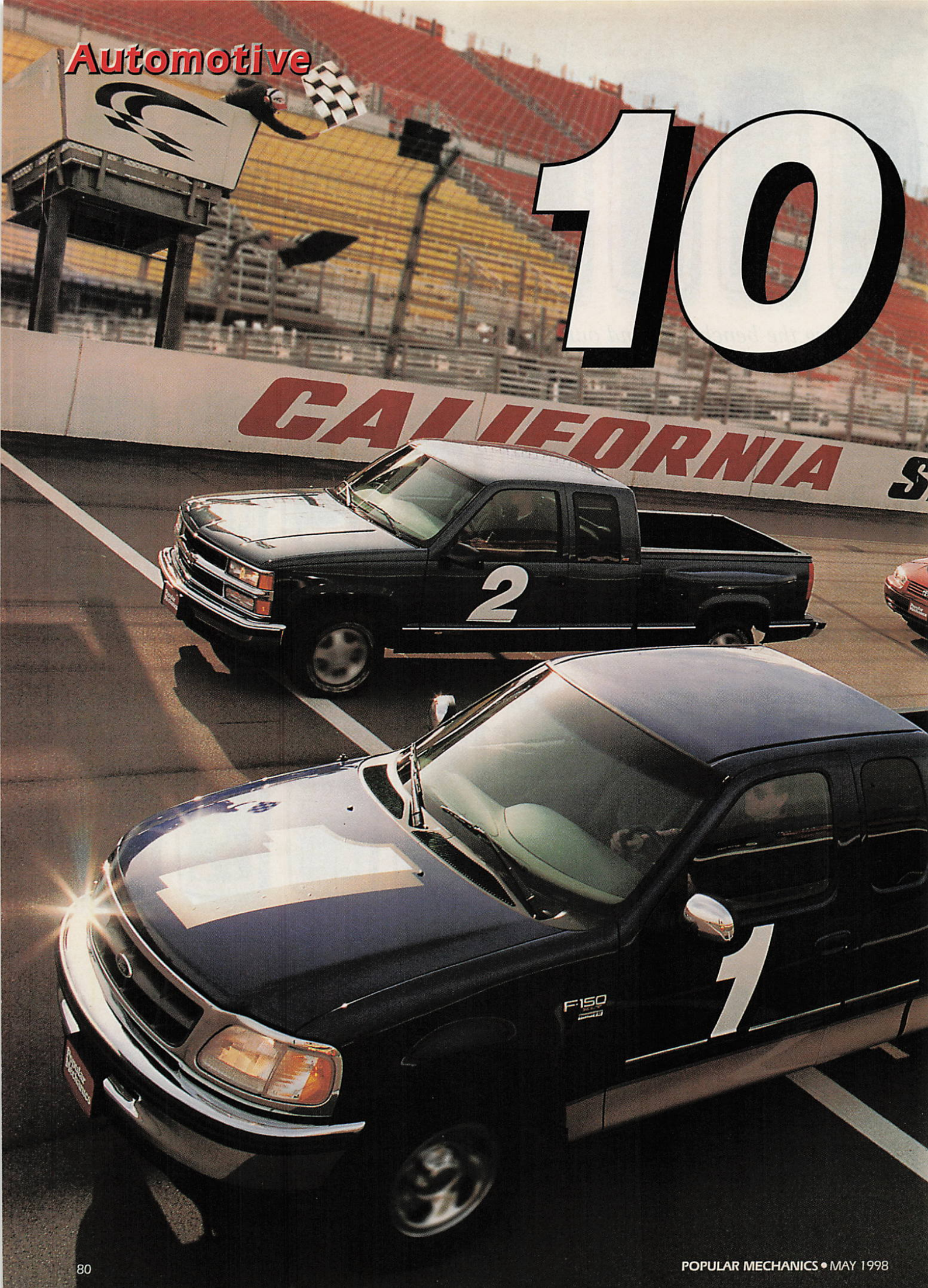


Caravan The New Dodge

Always use seat belts. Remember a backseat is the safest place for children. Properly secure all cargo.

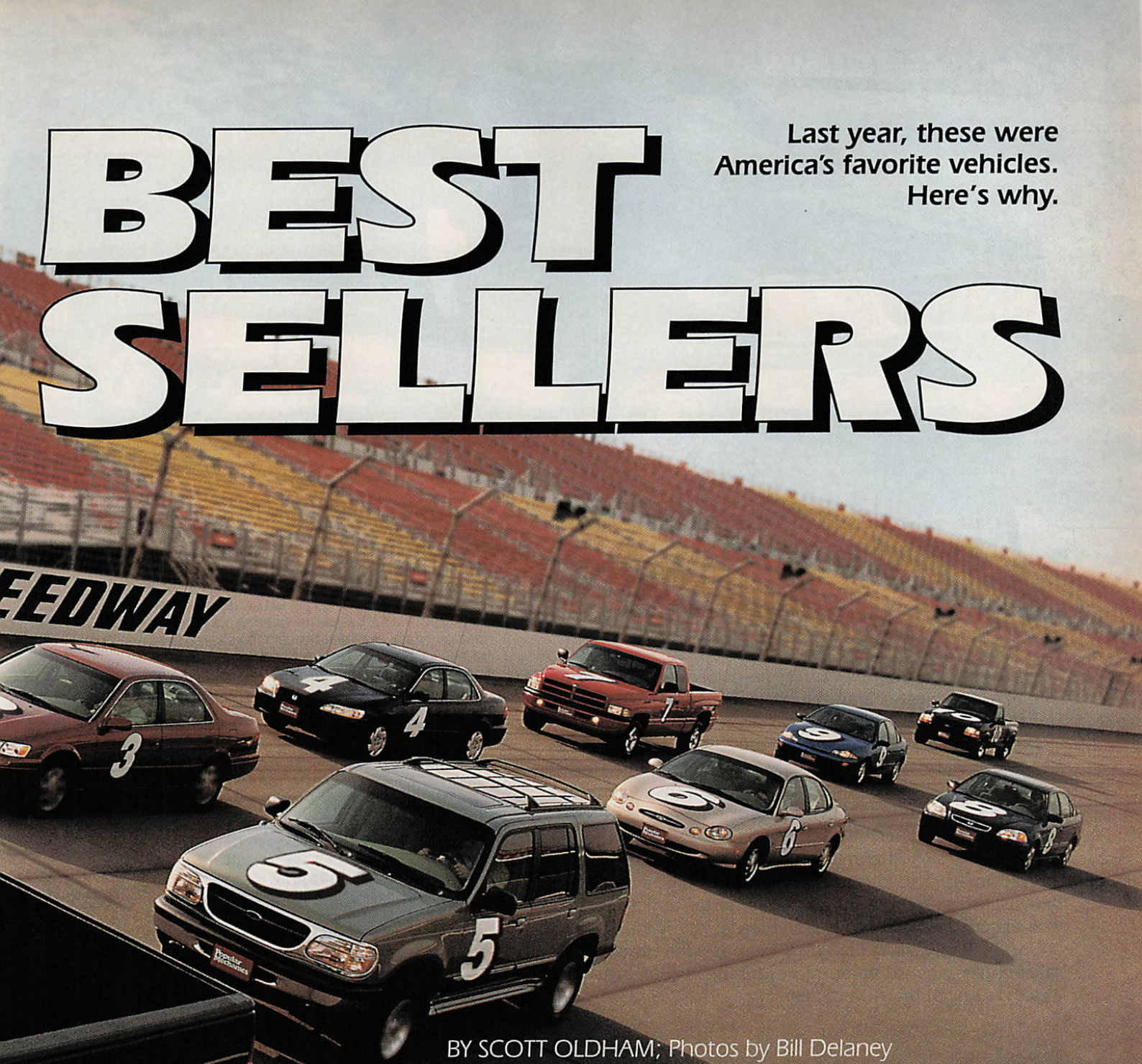
Automotive

10



BEST SELLERS

Last year, these were America's favorite vehicles. Here's why.



BY SCOTT OLDHAM; Photos by Bill Delaney

Americans bought nearly 15.2 million new cars and trucks in 1997, far more than were sold in any other country in the world.

The five cars and five trucks in this photo, with collective sales of more than 4 million, make up nearly a third of the entire new-vehicle market, leaving it to the other 209 cars and trucks for sale in the United States to duke it out in the hotly contested new-vehicle sales race.

But you have to wonder, why are these 10 the best sellers? Are they the fastest? Do they offer the greatest value? Are they the most dependable? The most comfortable? The best looking? The coolest? The cheapest? What is it about these 10 vehicles that have people flocking to them?

COMPARISON TEST

Some say they're simply marketed better than the others. Another theory is that there's psychological security in buying what's popular, meaning that people consider any one of these 10 vehicles to be a safe, smart purchase because their neighbor and their brother-in-law have one and they seem to like it.

To uncover the true virtues of these vehicles, we gathered examples of each and ran them all through our usual dynamic, objective- and subjective-test battery. For each run through the cones, there was a run to the supermarket. For each pass down the quarter mile, there was a traffic-clogged trip to the office. In order of sales, here are our test results.

1 Ford F-Series

1997 Sales: 746,111

From New Year's Day to New Year's Eve 1997, Ford sold one F-Series pickup truck every 40 seconds of every day—enough to make it the best-selling vehicle in America for the 16th year in a row.

Our test F-150 was powered by the 235-hp 5.4-liter overhead-cam V8 instead of the weaker 4.6-liter engine. Here's more proof that there's no replacement for displacement. This truck accelerated from 0-60 mph 2.5 seconds quicker than the F-150 we tested back in '96.

Combine that additional power with the most carlike ride of any pickup truck on the face of the planet, stable handling and the big Ford's very well-thought-out interior, and it's easy to see why this truck sells like chew and brew at a Winston Cup event.

But the F-150 is not perfect. It recorded the worst gas mileage, the slowest slalom time and the longest braking distances of any of the 10 vehicles.

SPECIFICATIONS

BASE PRICE: $21,095, **PRICE AS TESTED:** $27,125
ENGINE TYPE: sohc 16v V8, **DISPLACEMENT:** 5.4 liters/329.0 cu. in.
ENGINE HP (SAE net): 235 @ 4250 rpm, **TORQUE:** 330 ft.-lb. @ 3000 rpm
TRANSMISSION: 4A, **DRIVE:** rwd, **AXLE RATIO/TYPE:** 3.55:1/limited-slip
WHEELBASE: 138.5 in., **LENGTH:** 220.8 in., **WIDTH:** 78.4 in., **HEIGHT:** 72.7 in.
TRACK: FRONT: 65.4, REAR: 65.4 in., **BASE AXLE CLEARANCE:** 7.3 in.
CURB WEIGHT: 4351 lb., **WEIGHT/HP RATIO:** 18.5, **GVWR:** 6250 lb.
PAYLOAD: 1745 lb., **MAXIMUM TRAILER TOWING WEIGHT:** 8000 lb.
CAB: Ext., 3-dr., 5 seats, **INTERIOR, CARGO BED VOLUME:** 104.9, 58.6 cu. ft.
HEAD-/LEG-/HIPROOM: FRONT: 40.8/40.9/61.3, REAR: 37.8/32.2/64.9 in.
CARGO BED: LENGTH: 78.8, WIDTH: 65.2, BETWEEN WHEEL WELLS: 50.0 in.
STEERING: power recirc. ball, **RATIO:** 14.0:1, **TURNING CIRCLE:** 45.9 ft.
WHEEL SIZE & TYPE: 16x7-in. chromed steel, **FULL-SIZE SPARE?:** yes
TIRE BRAND, MODEL & SIZE: Goodyear Wrangler A/P, LT245/75R16
SUSPENSION (per side): FRONT: coil spring, A-arms, stabilizer bar, REAR: leaf spring, solid axle, trailing links
BRAKE SYSTEM: FRONT: 12.1-in. vented disc, ABS, REAR: 11-in. drum, ABS

TEST RESULTS

FUEL ECONOMY (EPA): 14 city/18 hwy, **PM TEST (AVG.):** 16.4 mpg
ACCELERATION: 0-60 MPH: 8.5 sec., 1/4 MILE[1]: 16.3 sec./83.2 mph
PASSING ACCELERATION (40-70 MPH)[2]: 6.6 sec.
BRAKING (60-0 MPH)[3]: 153 ft., **SKIDPAD** (200 FT.)[4]: 0.68 lateral g
SLALOM (525 FT.)[5]: 39.1 mph, **LANE CHANGE** (250 FT.)[6]: 49.4 mph
SOUND LEVELS (dBA)[7]: IDLE: 53.0, FULL THROTTLE: 78.5, 60 MPH: 73.8
POPULAR MECHANICS SERVICE INDEX[8]: 70

1. Best E.T./trap speed may be attained separately. **2.** Best time from 40-70 mph. **3.** Best stop hot or cold. **4.** Max. g-force around a 200-ft.-dia. circle. Average of best cw and ccw. **5.** Best speed weaving through eight cones 75 ft. apart. Index of transient response. **6.** Best speed through a double lane change. **7.** Average of two readings. **8.** Based on 60 weighted tasks.

2 Chevy C/K Pickup

1997 Sales: 553,729

Chevy's C/K has been the No. 2 seller for the past 20 years. In fact, even if you add in corporate twin GMC Sierra sales, it's still second to the Ford F-Series by 20,708 units in 1997.

The silver medalist offers buyers the most powerful V8 engines in the full-size pickup class, an ergonomic interior layout and added versatility with the optional third door. Still, the C/K is one behind the Dodge Ram Quad Cab in the door wars, and its back seat is uncomfortable enough for "NYPD Blue" Detective Sipowicz to use as an interrogation tool.

On the plus side: Power. This is the quickest of the trucks from a dead stop, and it has the strongest passing punch. It also easily outbraked the Ford and outmaneuvered it in the slalom. The Chevy's tires contribute to a bouncy highway ride when the truck's bed is empty. Around town, however, the Chevy soaks up the road as well as anything in the class.

3 Toyota Camry

1997 Sales: 397,156

For the first time, the Toyota Camry is the best-selling car in America, outselling the most recent past champions, the Honda Accord and the Ford Taurus. With good reason.

We praise the Camry for its performance, but its high build quality and its comfort are also responsible for its popularity. This car is put together beautifully. It feels solid, like it won't fall apart after 50,000 miles. It also feels like a luxury car in the way it soaks up the road and isolates its occupants from the harsh world outside.

In our last test with the prior-generation Accord, the Camry left the Honda in its dust. This time, only a tenth of a second separated the two in the 0-60 mph and quarter-mile acceleration contests, with the new-generation Accord taking the win. The Camry came back strong, however, outstopping the Accord and outmaneuvering the Honda on the skidpad and in the slalom run.

SPECIFICATIONS

BASE PRICE: $22,558, **PRICE AS TESTED:** $24,262
ENGINE TYPE: dohc 24v V6, **DISPLACEMENT:** 3.0 liters/182.8 cu. in.
ENGINE HP (SAE net): 192 @ 5200 rpm, **TORQUE:** 207 ft.-lb. @ 4400 rpm
TRANSMISSION: 4A, **DRIVE:** fwd, **FINAL DRIVE RATIO:** 3.93:1
WHEELBASE: 105.2 in., **LENGTH:** 188.5 in., **WIDTH:** 70.1 in.
HEIGHT: 55.4 in., **TRACK:** FRONT: 61.1, REAR: 59.9 in.
CURB WEIGHT: 3241 lb., **WEIGHT/HP RATIO:** 16.9
MAXIMUM TRAILER TOWING WEIGHT: 2000 lb.
BODY STYLE: 4-dr., 5 seats, **INTERIOR CARGO VOLUME:** 96.9, 14.1 cu. ft.
HEAD-/LEG-/HIPROOM: FRONT: 38.6/43.5/54.0, REAR: 37.6/35.5/54.1 in.
REAR SEAT SPLIT %: 60/40, **FOLD-DOWN RELEASES:** on seat tops
STEERING: power rack & pinion, **RATIO:** 17.4:1, **TURNING CIRCLE:** 35.4 ft.
WHEEL SIZE & TYPE: 15x6-in. aluminum alloy, **FULL-SIZE SPARE?:** yes
TIRE BRAND, MODEL & SIZE: Dunlop Radial, P205/65R15
SUSPENSION (per side): FRONT: MacPherson strut, A-arm, stabilizer bar, REAR: Chapman strut, multiple links, stabilizer bar
BRAKES: FRONT: 10.7-in. vented disc, ABS, REAR: 11.3-in. disc, ABS

TEST RESULTS

FUEL ECONOMY (EPA): 19 city/27 hwy, **PM TEST (AVG.):** 21.4 mpg
ACCELERATION: 0-60 MPH: 7.9 sec., 1/4 MILE[1]: 15.9 sec./82.9 mph
PASSING ACCELERATION (40-70 MPH)[2]: 6.1 sec.
BRAKING (60-0 MPH)[3]: 126 ft., **SKIDPAD** (200 FT.)[4]: 0.74 lateral g
SLALOM (525 FT.)[5]: 44.5 mph, **LANE CHANGE** (250 FT.)[6]: 50.3 mph
SOUND LEVELS (dBA)[7]: IDLE: 49.4, FULL THROTTLE: 78.4, 60 MPH: 74.0
POPULAR MECHANICS SERVICE INDEX[8]: 88

SPECIFICATIONS

BASE PRICE: $23,099, **PRICE AS TESTED:** $27,757
ENGINE TYPE: ohv 16v V8, **DISPLACEMENT:** 5.7 liters/350.0 cu. in.
ENGINE HP (SAE net): 255 @ 4600 rpm, **TORQUE:** 330 ft.-lb. @ 2800 rpm
TRANSMISSION: 4A, **DRIVE:** rwd, **AXLE RATIO/TYPE:** 3.73:1/open
WHEELBASE: 141.5 in., **LENGTH:** 218.5 in., **WIDTH:** 76.8 in., **HEIGHT:** 70.6 in.
TRACK: FRONT: 63.6, REAR: 64.6 in., **BASE AXLE CLEARANCE:** 6.6 in.
CURB WEIGHT: 4173 lb., **WEIGHT/HP RATIO:** 16.4, **GVWR:** 6200 lb.
PAYLOAD: 2027 lb., **MAXIMUM TRAILER TOWING WEIGHT:** 7000 lb.
CAB: Ext., 3-dr., 5 seats, **INTERIOR, CARGO BED VOLUME:** 105.1, 42.9 cu. ft.
HEAD-/LEG-/HIPROOM: FRONT: 40.0/41.5/60.1, REAR: 38.0/28.7/66.1 in.
CARGO BED: LENGTH: 78.7, WIDTH: 49.1, BETWEEN WHEEL WELLS: 49.1 in.
STEERING: power recirc. ball, **RATIO:** 15.0:1, **TURNING CIRCLE:** 45.7 ft.
WHEEL SIZE & TYPE: 15x7-in. aluminum alloy, **FULL-SIZE SPARE?:** yes
TIRE BRAND, MODEL & SIZE: Uniroyal Tigerpaw, P235/75R15
SUSPENSION (per side): FRONT: coil spring, A-arms, stabilizer bar, REAR: leaf spring, solid axle, trailing links
BRAKE SYSTEM: FRONT: 11.6-in. vented disc, ABS, REAR: 10-in. drum, ABS

TEST RESULTS

FUEL ECONOMY (EPA): 14 city/19 hwy, **PM TEST (AVG.):** 17.4 mpg
ACCELERATION: 0-60 MPH: 8.3 sec., 1/4 MILE[1]: 16.2 sec./85.6 mph
PASSING ACCELERATION (40-70 MPH)[2]: 6.2 sec.
BRAKING (60-0 MPH)[3]: 145 ft., **SKIDPAD** (200 FT.)[4]: 0.62 lateral g
SLALOM (525 FT.)[5]: 40.2 mph, **LANE CHANGE** (250 FT.)[6]: 47.8 mph
SOUND LEVELS (dBA)[7]: IDLE: 50.6, FULL THROTTLE: 82.8, 60 MPH: 72.1
POPULAR MECHANICS SERVICE INDEX[8]: 78

4 Honda Accord

1997 Sales: 384,609

It's amazing how close the Toyota Camry and Honda Accord are in specifications and in performance. These two cars run head to head like high-school football rivals. In our test procedure, whichever test the Accord won, the Camry came in second and near vice versa. The Accord set the pace for all 10 vehicles in acceleration, passing power, lane-change efficiency and fuel economy, plus it had the quietest interior at full throttle and at 60 mph.

The new-generation Accord is larger than its predecessor, so we can't mock it for its lack of room anymore, and it has a range of little features that even the Camry lacks. Things like a 2-tier console bin, a valet-lock for the folding rear seat and pockets in the front seatbacks make this car special. No stone was left unturned.

5 Ford Explorer

1997 Sales: 383,852

We often wonder why some people would rather drive an uncomfortable, slow, ill-handling truck rather than a comfy, quick, agile car. And the answer is, they wouldn't. That's why most SUV buyers purchase a Ford Explorer. Check out these numbers: The Explorer has a quieter interior on the highway than the Taurus or the Chevy Cavalier. It outhandled the Taurus and the Cavalier in the lane-change test, equaled the Accord's time through the slalom and outstopped the Cavalier and the Taurus. It was the fourth quickest to 60 mph, and the fifth quickest through the quarter mile. And the ride is as good as for most cars. Inside, things are just as impressive. There's a CD changer in the center console, a power glass sunroof, good rear seat room, rear air-conditioning vents, rear cup holders and rear stereo controls for the kids, a built-in child seat, and nobody ever complains about the view provided by the high seating position. No wonder they sell so many of them.

SPECIFICATIONS

BASE PRICE: $26,620, **PRICE AS TESTED:** $32,315
ENGINE TYPE: sohc 12v V6, **DISPLACEMENT:** 4.0 liters/245.0 cu. in.
ENGINE HP (SAE net): 205 @ 5000 rpm, **TORQUE:** 250 ft.-lb. @ 3000 rpm
TRANSMISSION: 5A, **DRIVE:** awd, **AXLE RATIO/TYPE:** 3.73:1/limited-slip
WHEELBASE: 111.6 in., **LENGTH:** 189.5 in., **WIDTH:** 70.2 in., **HEIGHT:** 67.5 in.
TRACK: FRONT: 58.5, REAR: 58.5 in., **BASE AXLE CLEARANCE:** 6.7 in.
CURB WEIGHT: 4081 lb., **WEIGHT/HP RATIO:** 19.9, **GVWR:** 5340 lb.
PAYLOAD: 1259 lb., **MAXIMUM TRAILER TOWING WEIGHT:** 5640 lb.
BODY: 4-dr., 5 seats, **INTERIOR, MAX. CARGO VOLUME:** 103.0, 81.0 cu. ft.
HEAD-/LEG-/HIPROOM: FRONT: 39.9/42.4/51.9, REAR: 39.3/36.8/51.9 in.
REAR SEAT SPLIT %: 60/40, **REAR DOOR CONFIGURATION:** liftgate w/liftglass
STEERING: power rack & pinion, **RATIO:** 17.0:1, **TURNING CIRCLE:** 37.3 ft.
WHEEL SIZE & TYPE: 15x7-in. aluminum alloy, **FULL-SIZE SPARE?:** yes
TIRE BRAND, MODEL & SIZE: Firestone Wilderness, P225/70R15
SUSPENSION (per side): FRONT: torsion bar, A-arms, stabilizer bar, REAR: leaf spring, solid axle, trailing links, stabilizer bar
BRAKES: FRONT: 11.3-in. vented disc, ABS, REAR: 11.2-in. disc, ABS

TEST RESULTS

FUEL ECONOMY (EPA): 15 city/19 hwy, **PM TEST (AVG.):** 18.6 mpg
ACCELERATION: 0-60 MPH: 8.4 sec., 1/4 MILE[1]: 16.3 sec./83.4 mph
PASSING ACCELERATION (40-70 MPH)[2]: 6.9 sec.
BRAKING (60-0 MPH)[3]: 141 ft., **SKIDPAD** (200 FT.)[4]: 0.64 lateral g
SLALOM (525 FT.)[5]: 42.3 mph, **LANE CHANGE** (250 FT.)[6]: 49.7 mph
SOUND LEVELS (dBA)[7]: IDLE: 52.6, FULL THROTTLE: 82.1, 60 MPH: 75.4
POPULAR MECHANICS SERVICE INDEX[8]: 76

SPECIFICATIONS

BASE PRICE: $21,500, **PRICE AS TESTED:** $22,124
ENGINE TYPE: sohc 24v V6, **DISPLACEMENT:** 3.0 liters/183.0 cu. in.
ENGINE HP (SAE net): 200 @ 5500 rpm, **TORQUE:** 195 ft.-lb. @ 4700 rpm
TRANSMISSION TYPE: 4A, **DRIVE:** fwd, **FINAL DRIVE RATIO:** 4.2:1
WHEELBASE: 106.9 in. **LENGTH:** 188.8 in., **WIDTH:** 70.3 in.
HEIGHT: 57.3 in., **TRACK:** FRONT: 61.2, REAR: 60.4 in.
CURB WEIGHT: 3241 lb., **WEIGHT/HP RATIO:** 16.2
MAXIMUM TRAILER TOWING WEIGHT: 1000 lb.
BODY STYLE: 4-dr., 5 seats, **INTERIOR, CARGO VOLUME:** 101.7, 14.1 cu. ft.
HEAD-/LEG-/HIPROOM: FRONT: 40.0/42.1/54.9, REAR: 37.6/37.9/54.1 in.
REAR SEAT SPLIT %: full fold, **FOLD-DOWN RELEASES:** on seat top and in trunk
STEERING: power rack & pinion, **RATIO:** 15.8:1, **TURNING CIRCLE:** 36.4 ft.
WHEEL SIZE & TYPE: 15x6.5-in. steel w/covers, **FULL-SIZE SPARE?:** no
TIRE BRAND, MODEL & SIZE: Bridgestone Turanza EL42, P205/65R15
SUSPENSION (per side): FRONT: coil/strut, A-arm/lower links, stab. bar, REAR: Chapman strut, multiple links, stabilizer bar
BRAKES: FRONT: 11.1-in. vented disc, ABS, REAR: 10.2-in. disc, ABS

TEST RESULTS

FUEL ECONOMY (EPA): 20 city/28 hwy, **PM TEST (AVG.):** 27.9 mpg
ACCELERATION: 0-60 MPH: 7.8 sec., 1/4 MILE[1]: 15.8 sec./88.9 mph
PASSING ACCELERATION (40-70 MPH)[2]: 5.5 sec.
BRAKING (60-0 MPH)[3]: 136 ft., **SKIDPAD** (200 FT.)[4]: 0.73 lateral g
SLALOM (525 FT.)[5]: 42.3 mph, **LANE CHANGE** (250 FT.)[6]: 52.0 mph
SOUND LEVELS (dBA)[7]: IDLE: 50.0, FULL THROTTLE: 77.7, 60 MPH: 72.0
POPULAR MECHANICS SERVICE INDEX[8]: 67

We don't like the Accord's driving position or the lack of thigh support in the front seats. Nor do we like its tendency to fishtail when you snap out of the throttle mid-corner, something the sports car guys call lift-throttle oversteer. But there's no denying that the Accord is better than ever.

6 Ford Taurus

1997 Sales: 357,162

Once the nation's top-selling car, the Taurus now lags behind the Camry and Accord in sales and in our tests. Our test car was a Taurus SE, a new sportier model. But still, the SE got its rear deck spoiler sucked off by the much quicker accelerating Accord and Camry. The Taurus's brakes were also unimpressive, outbraked by every other vehicle in the test except the F-150. Our test Taurus's lack of ABS surely had something to do with that. In the handling tests, the Taurus showed no real bad habits, but no real grip either, finishing mid-pack or worse most of the time. Embarrassingly, a pickup truck outmaneuvered the Taurus in each test, and all the pickup trucks we tested had a quieter interior than the Taurus at 60 mph. Track testing aside, the Taurus drives well, it's comfortable and it feels solid. Helping its case are nice features like rear air-conditioning vents, a split-fold rear seat and very ergonomic climate and radio controls.

SPECIFICATIONS

BASE PRICE: $19,445, **PRICE AS TESTED:** $23,040
ENGINE TYPE: dohc 24v V6, **DISPLACEMENT:** 3.0 liters/181.0 cu. in.
ENGINE HP (SAE net): 200 @ 5750 rpm, **TORQUE:** 200 ft.-lb. @ 4500 rpm
TRANSMISSION TYPE: 4A, **DRIVE:** fwd, **FINAL DRIVE RATIO:** 3.98:1
WHEELBASE: 108.5 in., **LENGTH:** 197.5 in., **WIDTH:** 73.0 in.
HEIGHT: 55.1 in., **TRACK:** FRONT: 61.6, REAR: 61.4 in.
CURB WEIGHT: 3256 lb., **WEIGHT/HP RATIO:** 16.3
MAXIMUM TRAILER TOWING WEIGHT: 1550 lb.
BODY STYLE: 4-dr., 5 seats, **INTERIOR, CARGO VOLUME:** 101.0, 15.8 cu. ft.
HEAD-/LEG-/HIPROOM: FRONT: 39.2/42.2/55.8, REAR: 36.2/38.9/56.3 in.
REAR SEAT SPLIT %: 60/40, **FOLD-DOWN RELEASES:** on seat tops
STEERING: power rack & pinion, **RATIO:** 16.9:1, **TURNING CIRCLE:** 38.0 ft.
WHEEL SIZE & TYPE: 15x6-in. aluminum alloy, **FULL-SIZE SPARE?:** no
TIRE BRAND, MODEL & SIZE: General Ameri Star G4S, P205/65R15
SUSPENSION (per side): FRONT: MacPherson strut, A-arm, stabilizer bar, REAR: Chapman strut, multiple links, stabilizer bar
BRAKE SYSTEM: FRONT: 10.8-in. vented disc, REAR: 8.9-in. drum

TEST RESULTS

FUEL ECONOMY (EPA): 18 city/27 hwy, **PM TEST (AVG.):** 24.3 mpg
ACCELERATION: 0-60 MPH: 8.5 sec., 1/4 MILE[1]: 16.2 sec./86.5 mph
PASSING ACCELERATION (40-70 MPH)[2]: 6.4 sec.
BRAKING (60-0 MPH)[3]: 148 ft., **SKIDPAD** (200 FT.)[4]: 0.70 lateral g
SLALOM (525 FT.)[5]: 42.7 mph, **LANE CHANGE** (250 FT.)[6]: 49.3 mph
SOUND LEVELS (dBA)[7]: IDLE: 56.0, FULL THROTTLE: 79.4, 60 MPH: 76.2
POPULAR MECHANICS SERVICE INDEX[8]: 74

7 Dodge Ram

1997 Sales: 350,257

SPECIFICATIONS

BASE PRICE: $19,770, **PRICE AS TESTED:** $28,310
ENGINE TYPE: ohv 16v V8, **DISPLACEMENT:** 5.2 liters/318.0 cu. in.
ENGINE HP (SAE net): 230 @ 4400 rpm, **TORQUE:** 300 ft.-lb. @ 3200 rpm
TRANSMISSION: 4A, **DRIVE:** rwd, **AXLE RATIO/TYPE:** 3.55:1/limited-slip
WHEELBASE: 138.7 in., **LENGTH:** 214.8 in., **WIDTH:** 79.3 in., **HEIGHT:** 65.6 in.
TRACK: FRONT: 66.9, REAR: 66.9 in., **BASE AXLE CLEARANCE:** 8.4 in.
CURB WEIGHT: 4758 lb., **WEIGHT/HP RATIO:** 20.7, **GVWR:** 6400 lb.
PAYLOAD: 1642 lb., **MAXIMUM TRAILER TOWING WEIGHT:** 4700 lb.
CAB: Ext., 4-dr., 6 seats, **INTERIOR, CARGO BED VOLUME:** 111.2, 55.5 cu. ft.
HEAD-/LEG-/HIPROOM: FRONT: 40.2/41.0/65.6, REAR: 39.4/31.6/66.8 in.
CARGO BED: LENGTH: 77.5, WIDTH: 64.2, BETWEEN WHEEL WELLS: 50.0 in.
STEERING TYPE: power recirc. ball, **RATIO:** 14.0:1, **TURNING CIRCLE:** 46.9 ft.
WHEEL SIZE & TYPE: 16x7-in. aluminum alloy, **FULL-SIZE SPARE?:** yes
TIRE BRAND, MODEL & SIZE: Michelin LTX A/S, P245/75R16
SUSPENSION (per side): FRONT: coil spring, A-arms, stabilizer bar, REAR: leaf spring, solid axle, trailing links
BRAKE SYSTEM: FRONT: 12.6-in. vented disc, ABS, REAR: 11-in. drum, ABS

TEST RESULTS

FUEL ECONOMY (EPA): 13 city/18 hwy, **PM TEST (AVG.):** 17.5 mpg
ACCELERATION: 0-60 MPH: 10.0 sec., 1/4 MILE[1]: 17.2 sec./79.7 mph
PASSING ACCELERATION (40-70 MPH)[2]: 8.2 sec.
BRAKING (60-0 MPH)[3]: 136 ft., **SKIDPAD** (200 FT.)[4]: 0.66 lateral g
SLALOM (525 FT.)[5]: 41.4 mph, **LANE CHANGE** (250 FT.)[6]: 51.9 mph
SOUND LEVELS (dBA)[7]: IDLE: 55.4, FULL THROTTLE: 85.8, 60 MPH: 74.0
POPULAR MECHANICS SERVICE INDEX[8]: 70

The Ram Quad Cab pickup takes interior access and comfort to new levels in this class. Ram now leads the door wars, but it's the quality of the design, not the quantity of the doors, that is truly impressive. Instead of just adding doors, Dodge redesigned the seats, which now have the seatbelts built in. This makes for a clean appearance and easier access to the very usable rear seat. In fact, the Dodge has by far the most comfortable and most usable rear seat of the Big Three.

The downside is weight. The Quad Cab adds a couple hundred pounds to the truck. That avoirdupois helped make this Ram significantly slower than both the Ford and the Chevy.

The Ram still outhandled and outbraked its rivals quite easily. Actually, the Ram was the second quickest of all 10 vehicles through the lane change, and it got better gas mileage than the F-Series and the C/K pickup.

8 Honda Civic

1997 Sales: 315,546

This is an impressive car. Our Civic EX tester was loaded, down to the optional CD player. Yet its as-tested price of $18,404 was the second lowest of all 10 vehicles.

What impressed us most about the Civic was its high performance. With only 127 hp, we didn't expect big acceleration numbers, and we didn't get them. But the Civic's braking and agility are extraordinary. It stopped better than the Accord, and only the Camry outran it through the slalom and around the skidpad. And it outhandled the Camry through the lane change. Plus, it had the fourth-best gas mileage and a quieter interior on the highway than the Camry, the Taurus or the Explorer.

SPECIFICATIONS

BASE PRICE: $17,280, **PRICE AS TESTED:** $18,404
ENGINE TYPE: sohc 16v I4, **DISPLACEMENT:** 1.6 liters/97.0 cu. in.
ENGINE HP (SAE net): 127 @ 6600 rpm, **TORQUE:** 107 ft.-lb. @ 5500 rpm
TRANSMISSION TYPE: 4A, **DRIVE:** fwd, **FINAL DRIVE RATIO:** 4.36:1
WHEELBASE: 103.2 in., **LENGTH:** 175.1 in., **WIDTH:** 67.1 in.
HEIGHT: 54.7 in., **TRACK:** FRONT: 58.1, REAR: 58.1 in.
CURB WEIGHT: 2558 lb., **WEIGHT/HP RATIO:** 20.1
MAXIMUM TRAILER TOWING WEIGHT: not recommended
BODY STYLE: 4-dr., 5 seats, **INTERIOR, CARGO VOLUME:** 89.8, 11.9 cu. ft.
HEAD-/LEG-/HIPROOM: FRONT: 38.2/42.7/50.0, REAR: 36.2/34.1/49.3 in.
REAR SEAT SPLIT %: 60/40, **FOLD-DOWN RELEASES:** on seat tops
STEERING: power rack & pinion, **RATIO:** 17.7:1, **TURNING CIRCLE:** 32.8 ft.
WHEEL SIZE & TYPE: 14x5-in. steel w/covers, **FULL-SIZE SPARE?:** no
TIRE BRAND, MODEL & SIZE: Firestone Radial, P185/65R14
SUSPENSION (per side): FRONT: coil/strut, A-arm/lower links, stab. bar, REAR: Chapman strut, trailing arm w/lateral links
BRAKES: FRONT: 10.3-in. vented disc, ABS, REAR: 7.9-in. drum, ABS

TEST RESULTS

FUEL ECONOMY (EPA): 28 city/35 hwy, **PM TEST (AVG.):** 22.7 mpg
ACCELERATION: 0-60 MPH: 10.3 sec., 1/4 MILE[1]: 17.6 sec./77.1 mph
PASSING (40-70 MPH)[2]: 8.9 sec., **BRAKING** (60-0 MPH)[3]: 132 ft.
SKIDPAD (200 FT.)[4]: 0.73 lateral g, **SLALOM** (525 FT.)[5]: 44.4 mph
LANE CHANGE (250 FT.)[6]: 50.9 mph
SOUND (dBA)[7]: IDLE: 52.2, FULL: 84.0, 60 MPH: 73.4
POPULAR MECHANICS SERVICE INDEX[8]: 83

SPECIFICATIONS

BASE PRICE: $12,925, **PRICE AS TESTED:** $14,430
ENGINE TYPE: ohv 8v I4, **DISPLACEMENT:** 2.2 liters/134.0 cu. in.
ENGINE HP (SAE net): 115 @ 5000 rpm, **TORQUE:** 135 ft.-lb. @ 3600 rpm
TRANSMISSION TYPE: 3A, **DRIVE:** fwd, **FINAL DRIVE RATIO:** 3.18:1
WHEELBASE: 104.1 in., **LENGTH:** 180.7 in., **WIDTH:** 67.9 in.
HEIGHT: 54.7 in., **TRACK:** FRONT: 57.6, REAR: 56.7 in.
CURB WEIGHT: 2630 lb., **WEIGHT/HP RATIO:** 22.9
MAXIMUM TRAILER TOWING WEIGHT: 1000 lb. (only w/2.4L I4, 4A trans.)
BODY STYLE: 4-dr., 5 seats, **INTERIOR, CARGO VOLUME:** 95.0, 13.6 cu. ft.
HEAD-/LEG-/HIPROOM: FRONT: 38.9/42.3/50.8, REAR: 37.2/34.4/50.6 in.
REAR SEAT SPLIT %: full fold, **FOLD-DOWN RELEASES:** on seat top
STEERING: power rack & pinion, **RATIO:** 14.7:1, **TURNING CIRCLE:** 35.6 ft.
WHEEL SIZE & TYPE: 15x6-in. steel w/covers, **FULL-SIZE SPARE?:** no
TIRE BRAND, MODEL & SIZE: BFGoodrich Touring T/A, P195/65R15
SUSPENSION (per side): FRONT: MacPherson strut, A-arm,
REAR: Chapman strut, beam axle
BRAKES: FRONT: 10.2-in. vented disc, ABS, REAR: 7.9-in. drum, ABS

TEST RESULTS

FUEL ECONOMY (EPA): 23 city/29 hwy, **PM TEST (AVG.):** 24.6 mpg
ACCELERATION: 0-60 MPH: 10.8 sec., 1/4 MILE[1]: 17.7 sec./77.6 mph
PASSING (40-70 MPH)[2]: 8.7 sec., **BRAKING** (60-0 MPH)[3]: 144 ft.
SKIDPAD[4]: 0.71 lateral g, **SLALOM** (525 FT.)[5]: 42.5 mph
LANE CHANGE (250 FT.)[6]: 49.2 mph
SOUND (dBA)[7]: IDLE: 48.5, FULL: 84.4, 60 MPH: 76.6
POPULAR MECHANICS SERVICE INDEX[8]: 70

9 Chevy Cavalier

1997 Sales: 302,161

The Chevy has achieved its outstanding sales record through aggressive pricing, solid quality and a list of features longer than Shaq's arms. But buyers keep coming to Cavalier for one thing—value. With an as-tested price of $14,430, which includes ABS, a cassette stereo and air conditioning, it's easy to see why the Cavalier sells so well. Add the fact that the Cavalier got the second-best fuel economy, showed strong braking performance and was respectable and predictable through our handling tests, and this car becomes a great value that's fun to drive, too. The Cavalier's 2.2-liter 4-cylinder is very quiet at idle, but makes quite a racket at full throttle. The little Chevy also had the noisiest interior on the highway, which is mostly due to its optional and antiquated 3-speed automatic transmission. Alas, it was also the slowest car in the test.

10 Ford Ranger

1997 Sales: 298,796

We asked for a regular-cab Splash model, not because it's the most popular combination, but because it looks cool, even in our test truck's Welch's Grape Juice purple paint. The Splash's step-side flanks, with big, tough-looking rear fenders and those sharp chrome rims and fat tires may limit the truck's haulability because of the narrow bed. But the combo sure packs loads of style and flash. Those big wheels and tires and stiff suspension helped the Ranger finish near the top in all our handling tests. Its 3.0-liter V6 gave it little punch, however, and its brakes, which had just rear ABS, were only adequate. Still, out on the road this truck is fun. It has great steering, a cozy, sporty interior with quality controls, sports-car-like bolstered seats and an instrument layout that couldn't be better. PM

SPECIFICATIONS

BASE PRICE: $14,945, **PRICE AS TESTED:** $19,085
ENGINE TYPE: ohv 12v V6, **DISPLACEMENT:** 3.0 liters/182.0 cu. in.
ENGINE HP (SAE net): 150 @ 5000 rpm, **TORQUE:** 185 ft.-lb. @ 3750 rpm
TRANSMISSION TYPE: 4A, **DRIVE:** rwd, **AXLE RATIO/TYPE:** 3.73:1/open
WHEELBASE: 111.5 in., **LENGTH:** 188.7 in., **WIDTH:** 69.4 in., **HEIGHT:** 64.9 in.
TRACK: FRONT: 58.6, REAR: 57.3 in., **BASE AXLE CLEARANCE:** 6.6 in.
CURB WEIGHT: 3146 lb., **WEIGHT/HP RATIO:** 21.0, **GVWR:** 4420 lb.
PAYLOAD: 1260 lb., **MAXIMUM TRAILER TOWING WEIGHT:** 2000 lb.
CAB: Reg., 2-dr., 2 seats, **INTERIOR, CARGO BED VOLUME:** 56.6, 34.4 cu. ft.
HEAD-/LEG-/HIPROOM: 39.2/42.4/52.7 in.
CARGO BED: LENGTH: 71.7, WIDTH: 43.9 in., BETWEEN WHEEL WELLS: N/A
STEERING: power rack & pinion, **RATIO:** 21.8:1, **TURNING CIRCLE:** 38.9 ft.
WHEEL SIZE & TYPE: 15x7-in. chromed steel, **FULL-SIZE SPARE?:** yes
TIRE BRAND, MODEL & SIZE: Firestone Firehawk T, P235/60R15
SUSPENSION (per side): FRONT: coil spring, A-arms, stabilizer bar,
REAR: leaf spring, solid axle, stabilizer bar
BRAKE SYSTEM: FRONT: 10.3-in. vented disc, REAR: 9-in. drum, ABS

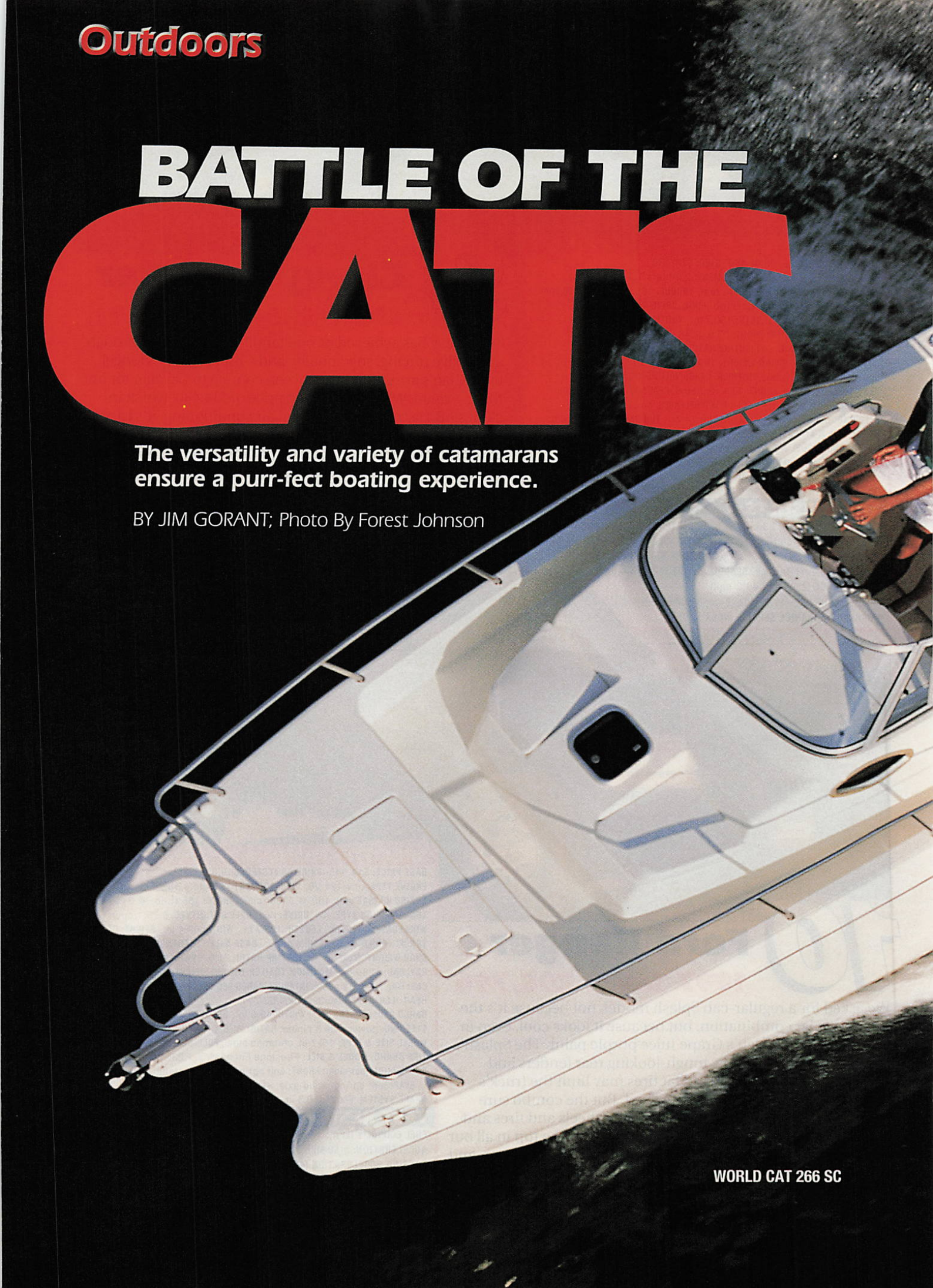
TEST RESULTS

FUEL ECONOMY (EPA): 17 city/22 hwy, **PM TEST (AVG.):** 20.2 mpg
ACCELERATION: 0-60 MPH: 10.6 sec., 1/4 MILE[1]: 17.7 sec./78.6 mph
PASSING ACCELERATION (40-70 MPH)[2]: 8.2 sec.
BRAKING (60-0 MPH)[3]: 147 ft., **SKIDPAD** (200 FT.)[4]: 0.73 lateral g
SLALOM (525 FT.)[5]: 43.9 mph, **LANE CHANGE** (250 FT.)[6]: 51.1 mph
SOUND LEVELS (dBA)[7]: IDLE: 53.9, FULL THROTTLE: 81.0, 60 MPH: 74.9
POPULAR MECHANICS SERVICE INDEX[8]: 72

BATTLE OF THE CATS

The versatility and variety of catamarans ensure a purr-fect boating experience.

BY JIM GORANT; Photo By Forest Johnson



WORLD CAT 266 SC

We hit the first wave at about 25 mph. The bow rose so high that only a cloud-scattered expanse of blue Florida sky was visible beyond the rail. As we hung in the air, I told myself: You should have backed off the throttle while you had the chance—moron.

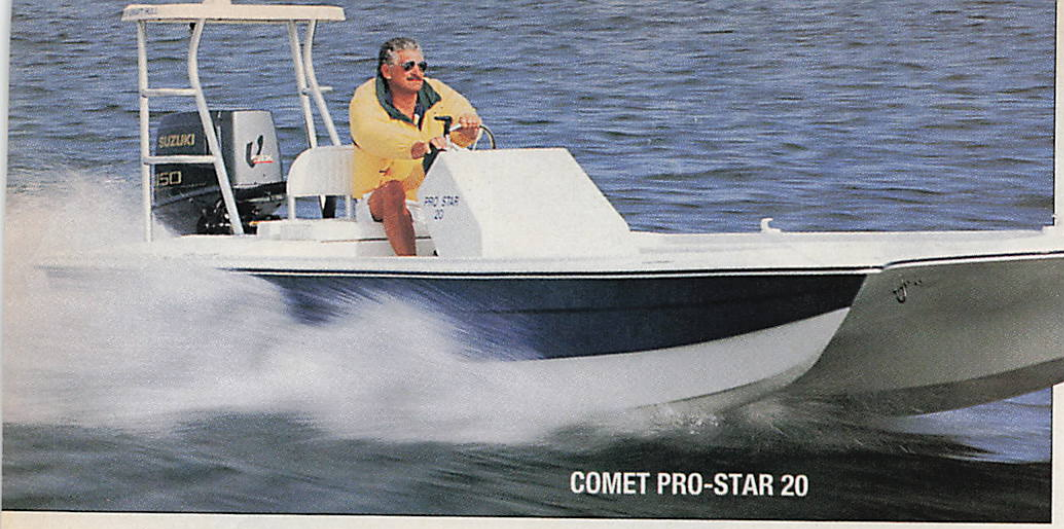
BOATING

Instead, I clutched the wheel, flexed my knees and waited for the inevitable sternum-crunching reunion with the water. But the impact that followed opened my eyes more than it loosened my fillings.

There was a mild shudder, a gentle compression into the water, and before I knew it we were heading right up the face of the next wave. Again I braced myself, and again the impact never came.

That day three years ago was the first time I rode a power catamaran, and I've been a fan ever since.

These multihulled boats have a number of long-known and seldom-disputed design advantages over monohulls. First, catamarans ride softer because they don't have a large, round bottom that slams against the waves. Second, a catamaran's twin hulls focus the buoyancy around the outside of the boat, rather than in



COMET PRO-STAR 20

the middle, creating greater initial stability. Third, the two narrow hulls generate about one-third as much wetted surface, or drag, making the boat more efficient. And last, the hulls place the engines farther apart, increasing maneuverability.

So why, you might ask, don't we see more catamarans on the water? After that ride, I asked the same question, and received a simple answer: They don't look right. When people buy a boat they want it to look like their image of a boat—a catamaran doesn't.

Despite this consistent consumer resistance, manufacturers have continued hawking catamarans in U.S. marinas. That cat I tested in 1995, the 25 SeaCat, was just one more entry into a boat class of proven sales failures.

But the SeaCat didn't fail. Some say it was the styling—from the side, at least, it looked almost like a typical boat. Some credit the marketing: With its fuel efficiency and soft ride the cat attracted fishermen with small wallets and grand offshore dreams. And some think the catamaran was just a boat design whose time had come.

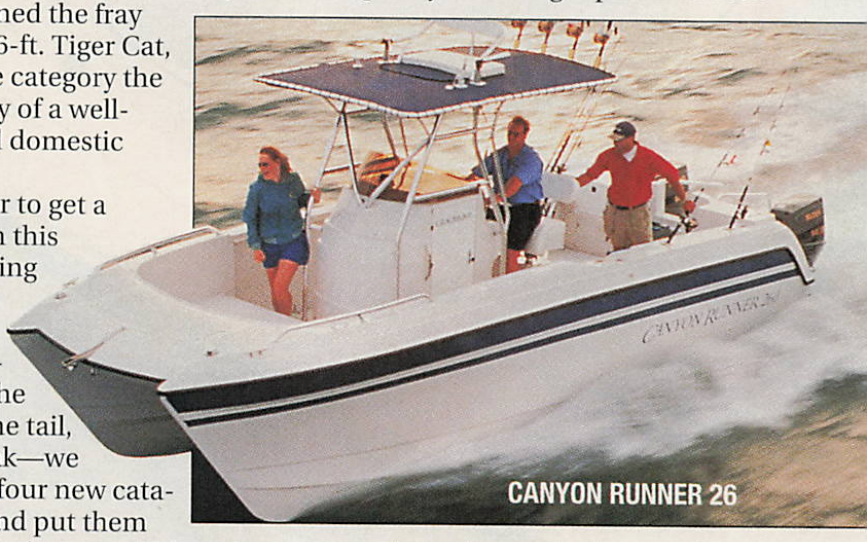
Whatever the reason, the SeaCat flourished, and today there are at least 15 companies selling power catamarans in this country. These cats range from 14 to 74 ft., although the majority fall between 19 and 33 ft. Last year, Grady White joined the fray with its 26-ft. Tiger Cat, giving the category the legitimacy of a well-respected domestic builder.

In order to get a handle on this fast-growing group of water wagons—to catch the tiger by the tail, so to speak—we gathered four new catamarans and put them through their paces. Although all four are nominally set up for fishing, we found very different boats that together are ready for almost anything.

Comet Pro-Star 20

This catamaran version of the increasingly popular flats boat is probably the most purpose-specific boat in our test. Like any good flats boat, it planes almost instantly and runs in shallow water. Relatively wide, flat hulls give the Comet lift, as proven by her 14-in. standing draft and ability to plane in 1.9 seconds. Meanwhile, a hydraulic jackplate lowers and raises the engine, allowing the boat to run in only 6 in. of water at full throttle.

Along with handsome blue hulls and nonskid decks, the Comet offers topnotch fit and finish. There's plenty of stowage space and recirculating live and release wells. The helm console has enough room for dash-mounted add-on electronics and is easy to reach from the comfortable bench seat.


CANYON RUNNER 26

SPECIFICATIONS AND TEST RESULTS

MODEL	COMET	GLACIER BAY
Price without engine	$16,900	$39,500
Length/Beam/Weight/Draft	20 ft. 6 in./8 ft./1500/12 in.	26 ft. 2 in./8 ft. 6 in./4400/16 in.
Fuel Capacity	66 gal.	180 gal.
Test Engines	1/150-hp Suzuki	2/150-hp Johnson Ficht
Speed/gph/Decibels @ Idle	2.6/1.0/64	2.5/.7/78
Speed/gph/Decibels @ 4000 rpm	28.8/7.8/84	28.3/14.2/96
Speed/gph/Decibels @ WOT	44.3/15.8/100	36.9/26.5/100
0-30 mph (sec.)	2.9	5.37
Address	3573 Arnold Ave., Naples, Florida 34104	17341 Tye St. SE, Monroe, Washington 98272
Speeds are 2-way averages in mph. On twin-engine boats, gph is for both engines. Weight is in pounds, without engines. Test team comments are to the right.	Could redefine performance criteria for flats skiffs.	Allows you to get out in weather that forces other 26-footers home.

SKIP GANDY PHOTOS (EXCLUDING GLACIER BAY)

The fuel efficiency and soft ride attract fishermen with small wallets and offshore grand dreams.

On the water, the Comet was steady in a chop that would have slowed other flats boats. Trimming it out lifted the bow, making it feel like a high-powered bass boat without the threat of chine walking. Through turns it stayed flat and in control.

SEAGULL 19

Glacier Bay Canyon Runner 26

Glacier Bay has been building power cats for 10 years, so it probably wouldn't agree that the 25 SeaCat popularized the category. Nevertheless, Glacier Bay hasn't exerted the same influence.

Not that its boats aren't worthy. The Canyon Runner was the only displacement-hulled catamaran in our test. And although this hull type sacrifices some speed at the top end, it makes up for it in ride. The boat ran through 3-ft. waves and over 5-footers with an almost eerie stability. What's more, it retained this smoothness in all directions to the sea. In high-speed, hard-over turns, the Glacier Bay stayed in complete control, although it did heel out a bit.

While the boat is set up for fishing, with fish boxes, live wells and rod holders, it makes a good all-around craft. It features quality components and is well-constructed. Still, its best attribute clearly is the ride. As one dealer aptly sums it up: "You just can't get in trouble in this boat."

Seagull 19

True to its catamaran heritage, the Seagull can make a bumpy bay seem paved and can sit beam-to in a heavy chop without making you want to feed the fish. But unlike many other cats, the Seagull has a looser and freer side too.

Since it sits so close to the water, the boat feels even faster than it is. Of course, those low sides also mean it'll take some spray in a cross-breeze, but somehow that's part of this boat's charm. There's a little more action in its ride, making it feel as if it's frolicking across the wave tops, and it turns so quickly that anyone not holding on before a sharp turn will probably be swimming afterward.

The high-gloss gelcoat looks great, but the construction and finish are more workmanlike than flashy. Set up as a general-purpose boat, the Seagull skis, fishes, dives and provides some welcome levity.

World Cat 266 SC

SeaCat's owner retired last year, and the new owners renamed the company World Class Catamaran and redesigned the entire line.

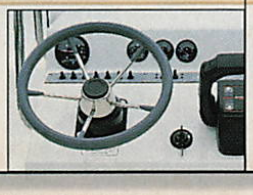
With its cuddy cabin and walk-around helm, the company's new World Cat 266 SC is the queen of that line. And the best compliment we can pay it is to say that it seems like a larger boat, both in terms of its amenities and ride.

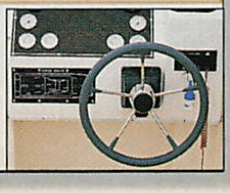
At speed, it's very sensitive to trim, especially if the engines are not trimmed evenly. But once it's properly adjusted, this boat is fast and makes the chop go away. It backs particularly well (generally, all cats do because there's less resistance) and stays almost perfectly flat during hard-over turns.

Inside, there are double bunks, a freshwater sink and portable head, all finished to respectable standards. These conveniences make the 266 SC great for a weekend getaway or an overnight stay at a kingfish tournament.

Overall, none of these boats disappointed our test team, but don't take my word for it. You've got to experience a power catamaran to believe it. Take one for a test ride, and then you'll understand why, at last, the power cat is here to stay. **PM**

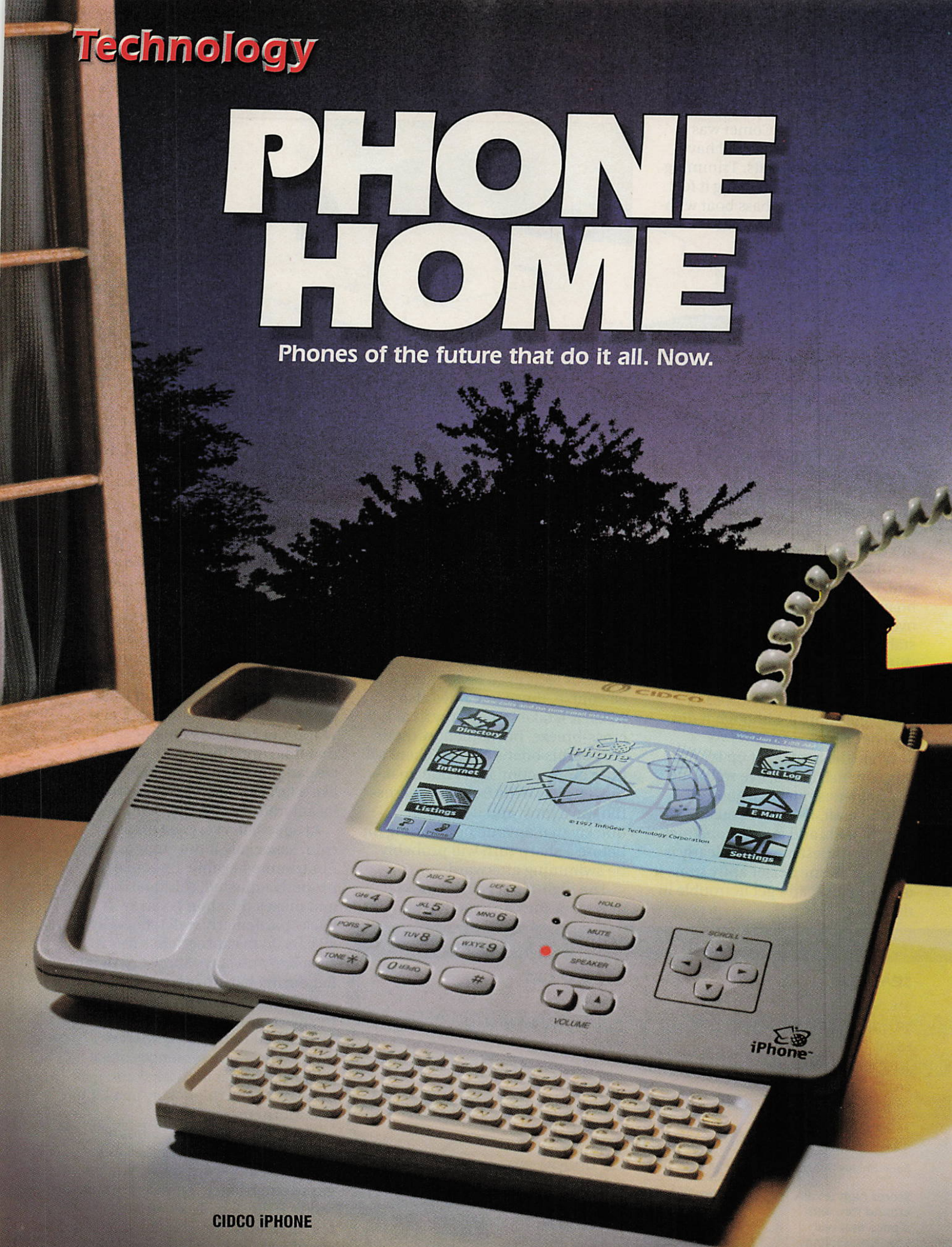
SEAGULL	WORLD CAT
$18,000	$38,450
19 ft. 3 in./8 ft. 6 in./1600/11 in.	26 ft. 6 in./8 ft. 6 in./4000/12 in.
55 gal.	200 gal.
1/150-hp Johnson Ficht	2/150-hp Johnson Ficht
3/.2/69	3.7/.3/62
28.1/7.6/90	33.3/17.9/88
36.7/13.8/100	46.5/26.3/94
5.41	5.25
5564 Shirley St., Naples, Florida 34109	801 Staton Rd., Greenville, NC 27834


Scores high on all-around fun, with a price that will keep you smiling.

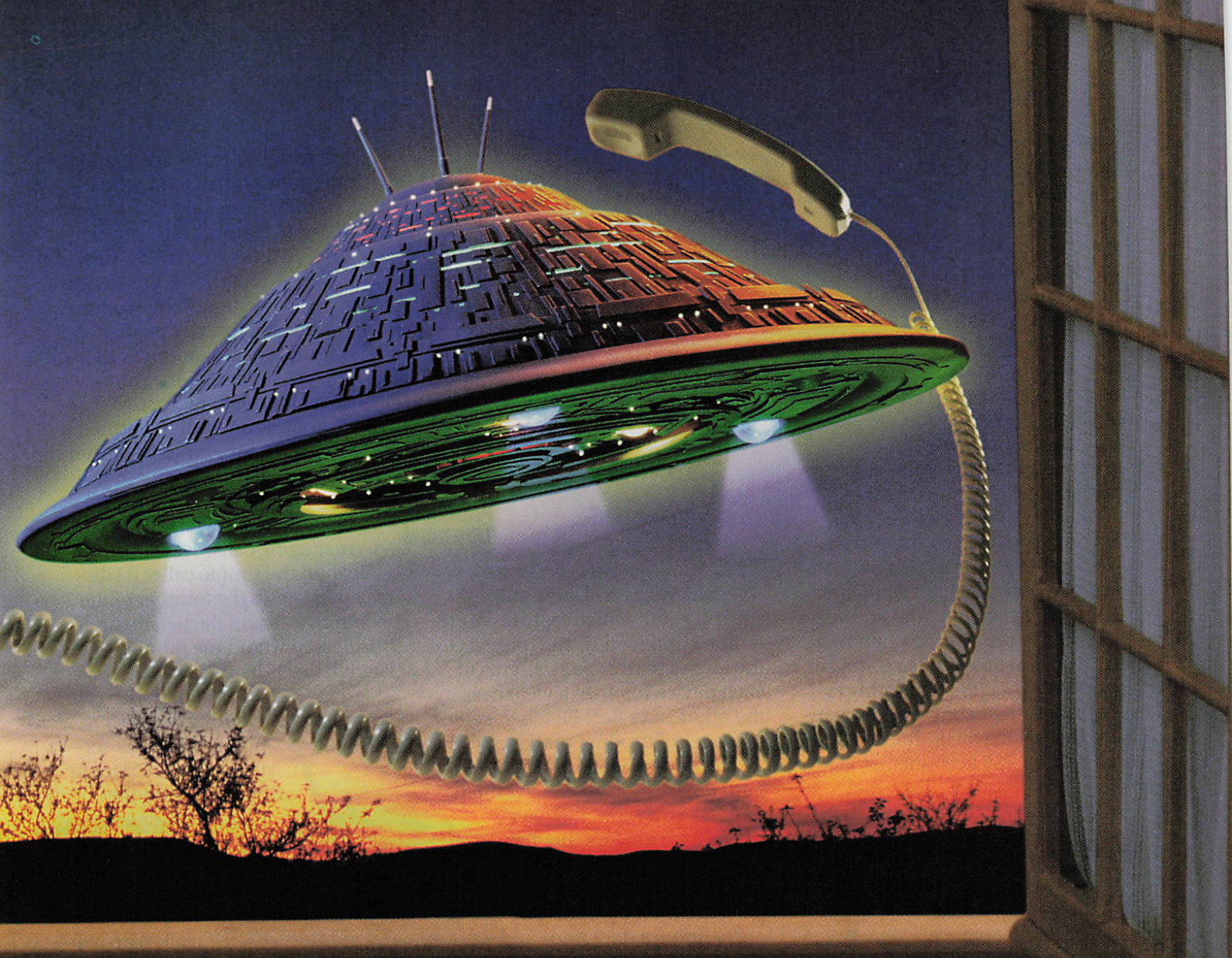

Rough-weather ability plus speed and amenities.

PHONE HOME

Phones of the future that do it all. Now.



CIDCO iPHONE



BY REBECCA DAY; Photo by Michel Tcherevkoff

TELECOMMUNICATIONS

Follow the evolution of the telephone and you've got a reference timeline for the age of technology. After all, it was Bell Labs that invented the transistor, speech synthesis and even stereo recording. And as digital innovations have revolutionized wireless, cordless and Internet communication, the home phone has kept pace.

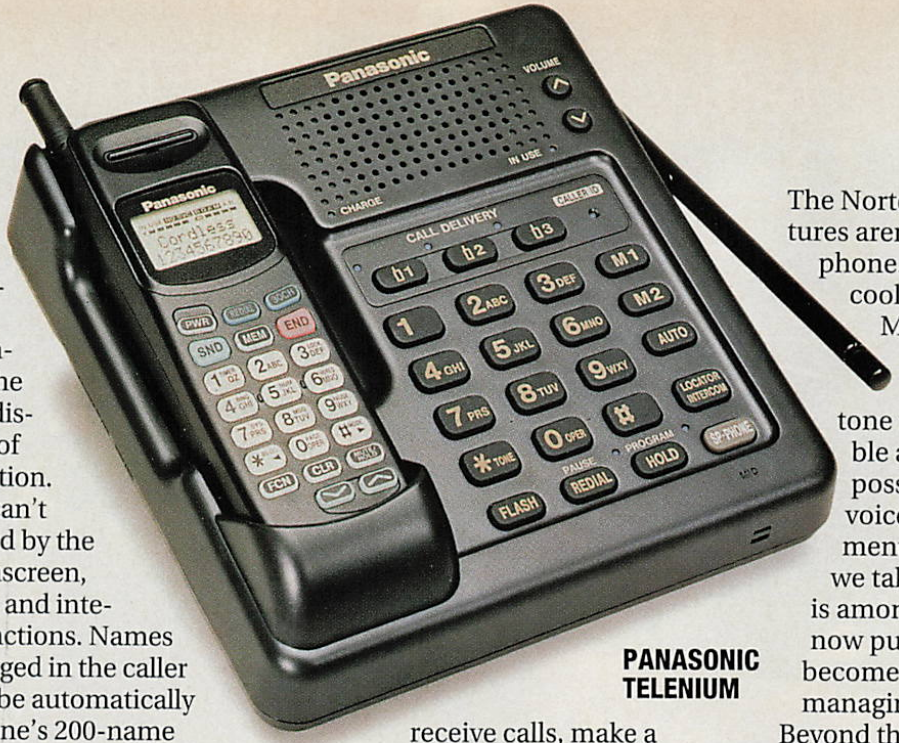
The most intriguing product to hit the kitchen counter recently is the screen phone, which is being offered by companies such as Cidco, Philips and Uniden for everything from displaying caller ID information to browsing the World Wide Web.

Among the more sophisticated, and expensive, of the screen phones is the Cidco iPhone. At $499, the iPhone is only half the price of low-end PCs—add the optional printer and full-size keyboard and you're still just three-quarters of the way to a bare-bones desktop computer. But the iPhone certainly isn't meant to take on Compaq, according to Cidco, which makes the product in a white finish to underscore its intended use as a kitchen communications center. Instead, says Bruce Gee, Cidco director of product marketing, iPhone's target customers either don't have a PC at home or don't want to take the time to boot up the PC just to check e-mail. In an informal e-mail test pitting an iPhone with a 14.4Kbps modem against a Dell 266-MHz PC with a 56Kbps modem, the iPhone dispatched a message in 34 seconds, outclocking the power-packed PC by 1:21.

Cidco's iPhone owes much of its speedy access to a streamlined package. Under the hood the phone packs a National Semiconductor 32-bit embedded processor—the same type used in fax machines and printers—1MB of flash RAM for storage of programs and user data, and a 2MB DRAM chip for running programs and caching data. The phone adopts the client-server relationship, in which the server does the heavy lifting, leaving the phone as a friendly user interface. According to Gee, the V.32 modem operates at 14.4Kbps, but performs like a 33.6Kbps modem thanks to the HTML codec, which strips Web pages of color and compresses graphics to speed up transmission.

PC users won't be tempted to junk their Pentiums for

an iPhone: The mini keyboard reduces everyone to hunt-and-peck typing, you can't store Net information, and the phone can't yet display a full frame of Internet information. But gadget fans can't help being wowed by the responsive touchscreen, speed, simplicity and integrated phone functions. Names and numbers logged in the caller ID directory can be automatically stored in the phone's 200-name directory with the tap of a Rolodex-like icon. Once names and addresses are stored in the directory, another tap of an icon takes you to e-mail or speed dial. The $19.95 monthly Internet fee is steep, but the company says users soon will be able to use their existing ISP accounts.



PANASONIC TELENIUM

If You Can't Beat 'Em, Join 'Em

While screen phones offer a non-PC alternative for e-mail and Web browsing, Nortel is taking a "convergence" approach with its Meridian 9617 phone that plugs into the USB port of a PC. Instead of trying to pack the phone with storage, memory and programs, the Nortel lets a PC handle the data via its Personal Call Manager software. The software gives you full control of any phone function from the phone or the PC and enables you to make and receive calls, make a conference call, and utilize caller ID and related features. Aptly dubbed application convergence, the idea is to use the strengths of each device to offset a weakness in the other, says Bert Fletcher, senior manager of product marketing.

The key is to offer the features in both devices so you can get them any way you want, Fletcher says. There are PCs that perform telephone functions, he notes, but how many people leave their computers on 24 hours a day? And the data storage capability of the Meridian 9617 is virtually unlimited because it uses the capacity of a PC's hard drive. When a call comes in, a window pops up on the monitor, giving the name and number (if you subscribe to caller ID) and any other data you have entered into the caller's listing in the PC directory.

The data could include notes, a scanned photo or a voice recording announcing the name of the caller. This could be useful if you're not near the phone or the computer, because you'll be able to hear who's calling via the phone's speaker. Priced at $329, which includes software and cable, the 9617 phone will be available simultaneous with the release of Windows 98.

UNIDEN EXV 98

The Nortel call-management features aren't restricted to the PC phone. Nortel has also stuffed cool features into its $279 Meridian 9516CW desktop phone/answering system. While touch-tone technology made possible a nearly infinite range of possibilities—including voice mail, interactive menus and other features we take for granted—Nortel is among those companies now pushing for caller ID to become the universal tool for managing calls.

Beyond the simple caller ID display that shows the number of the incoming call and the person or business to whom the number is registered, the 9516 offers caller ID combined with call waiting (another phone company service). If a call comes in while you're on the phone, you can see who's calling before you decide whether to take the second call. With Nortel's Call Announce feature, you can record the name of the caller along with a number in the 75-name directory, and both are announced through the speaker when a call comes from that number. With the phone's Personalized Greeting feature, you can leave a message for a particular person using the phone's recording feature. When the phone recognizes the incoming number, it plays the personalized message just for that caller.

SONY SPP-SS960

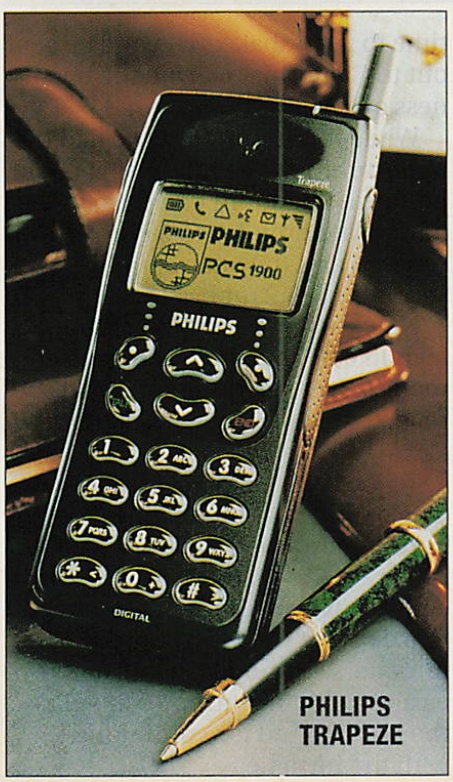
Cut The Cord

Cordless phones, too, are reaping the benefits of leapfrogging technology. The same kind of chip cost reductions that make more memory and power less costly in computers are also bringing better quality at more affordable prices to cordless phones.

Screen phones can do everything from displaying caller ID information to browsing the World Wide Web.

The Casio PhoneMate CP-850 uses state-of-the-art Digital Spread Spectrum (DSS) technology based on an efficient Rockwell chip. While the previous Casio model used a 10-part chip set, Casio has downsized the number to six for the CP-850. And while just over a year ago prices for Spread Spectrum phones approached $300, the CP-850 comes in at a suggested retail of $189.

Digital Spread Spectrum phones, which operate in the 902- to 928-MHz portion of the radio spectrum, are allowed a higher power output than conventional 46/49-MHz analog phones—or even their 900-MHz digital and analog counterparts. "Basic physics says that if you're able to transmit at a higher power, you're able to get a stronger signal into the receiver on the other end, and that allows you longer range," says Mark Karnowski, vice president of engineering at Casio. The ideal-world range of the CP-850 is up to 4000 ft.—seven times that of conventional analog 46/49-MHz phones.



PHILIPS
TRAPEZE

Digital Spread Spectrum is also known for its improved call security. Developed by the military, DSS is spread over a wide range of frequencies within the 900-MHz band, which enables the signal to avoid or eliminate interference from other signals.

Sony has jazzed up its SPP-SS960 Digital Spread Spectrum cordless phone ($229) with a "jog dial" the company imported from its camcorder line. Located on the left side of the phone, the dial moves like the volume dial on a transistor radio but adds a push feature that is used like an ENTER key to make selections. The phone is packed with a 50-number dialing directory and a 20-number caller ID directory—which could become cumbersome features on a menu-based phone. But the jog dial lets you spin through the numbers in the directory and a push translates into one-step dialing.

Uniden adds a new twist to the 900-MHz analog cordless phone market with its EXV 98 VoiceDial phone ($199). The phone uses a Sensory voice-activation chip from speech-recognition company Sensory Inc., which allows users to dial by speaking a name that is linked to a number in the phone's directory. Voice-recognition isn't a new technology, but previous implementations have been expensive and unreliable. The phone's RSC-164 chip uses neural network technology to achieve accuracy of 98%, Uniden claims.

Other 900-MHz analog cordless phones are making strong technological statements, too. Panasonic's tiny Telenium ($299) doubles as a cellular phone. When the base unit is plugged into the wall, Telenium operates in the 900-MHz band up to 1000 ft. away. When the handset is out of range, it automatically converts to cellular. The phone is also compatible with the IS-94 in-building wireless PBX protocol for people who spend a lot of time away from their desks.

NORTEL
MERIDIAN
9516CW

So the Telenium can be your home phone, cellphone (with a separate service account) and an extension to your office phone.

From double-duty cordless models to screen phones, to desk phones that work with a PC, new devices are pushing the limits of the most trusted and essential electronics appliance in the home: the telephone. PM

LONG-TERM TEST CARS

Goodbye to two world standards and hello to a very diverse trio.

Living in luxury

is quite nice. For a year, we've been suffering through life behind the wheels of two of the world's most prestigious luxury cars. But now those cars have been returned, replaced by equally interesting, though somewhat more affordable, rides. But lest you think driving is all sedans and minivans, we've also added a roadster.

Porsche Boxster

We'd be lying if we told you that living for a year with a Porsche wasn't, well, *great*! But we'd also be lying if we didn't admit that it was expensive. The red 1996 911 Carrera we tested still stands as the most expensive car we've ever had in our fleet. And it was right there at the *max* end of the maintenance-cost meter.

Porsche has been all too aware that cars with the family crest on them have been nearing the stratosphere in terms of cost. It was also aware that if something wasn't done, the company stood the real risk of becoming so exclusive that it could disappear. So it introduced a second model—the Boxster. It's cute, it's relatively affordable—compared with the 911—and it's fun. So when the car was introduced, we told the people at Porsche we'd like to try living with the more accessible, younger model.

Test Summary: Porsche Boxster
Report number: 1
Base price: $39,980
As-tested price: $44,901
Extra-cost options: Sport package, metallic paint, CD shelf, center console
Drivetrain: 2.5-liter dohc H6 engine, 5-speed manual transmission, rear-wheel drive
Engine performance: 201 hp/181 ft.-lb.
EPA fuel economy: 19 city/26 hwy.

Our deep blue Boxster arrived in time to get a shakedown and be sent out to California to avoid the harshness of a New York winter.

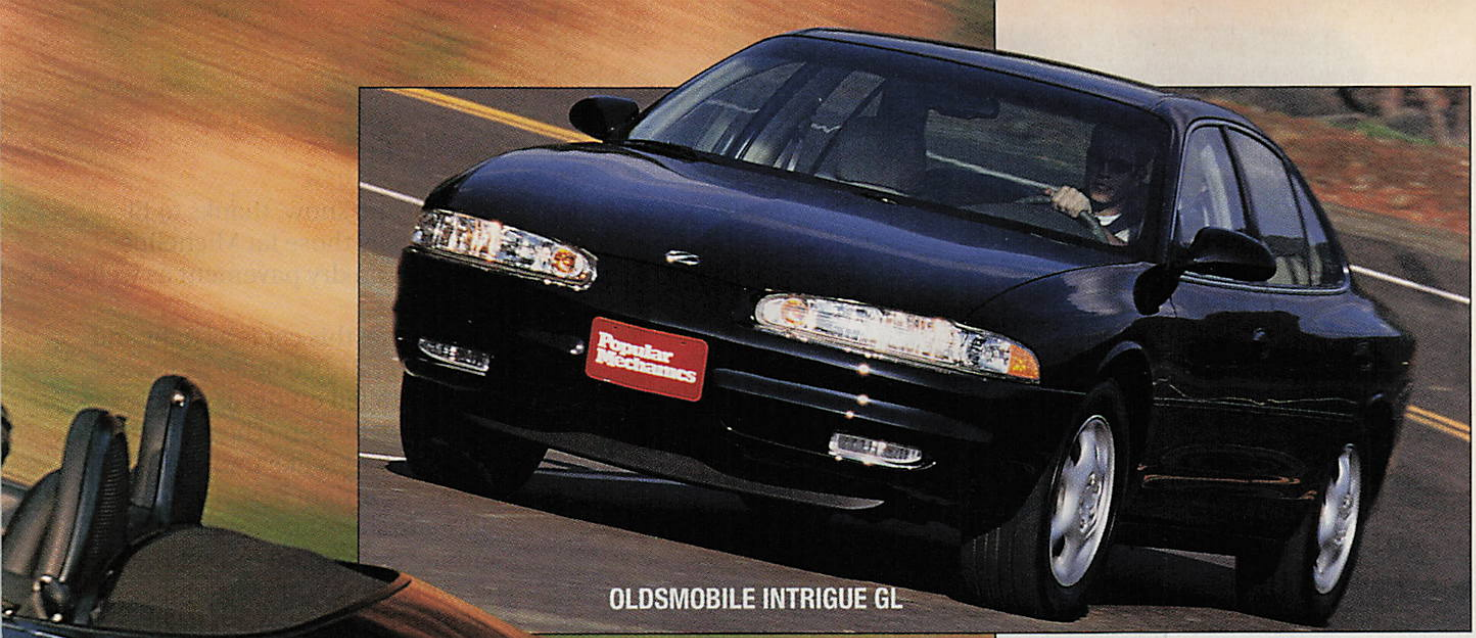
While it was out West, we had the opportunity to see how well it could perform. The squirt can do its nameplate proud: 0 to 60 mph in 6.2 seconds and the quarter mile in 14.3 seconds at 95.2 mph.

Now we'll see what the rest of life feels like behind the wheel of this modern, yet still traditional Porsche roadster. *—Don Chaikin*

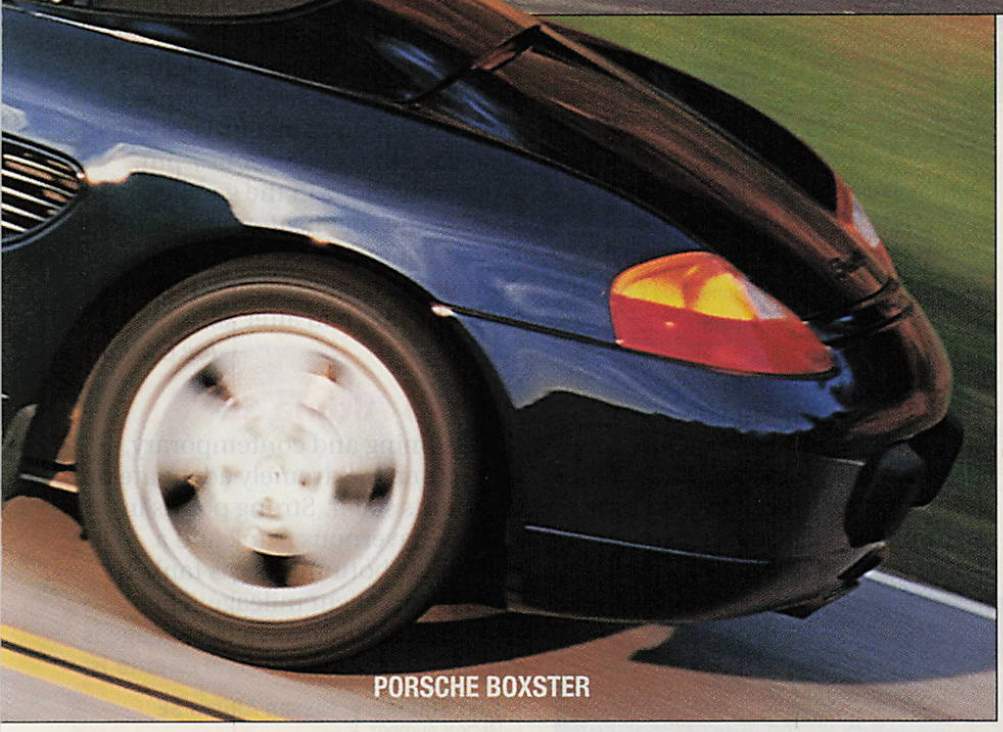
Oldsmobile Intrigue GL

One of the more interesting if perhaps underplayed stories currently in the auto industry is the deliberate, steady and absolutely stunning makeover of the oldest American marque: Oldsmobile. It began in earnest with the introduction of the Aurora. And it's continuing with the Intrigue.

PHOTOS BY LES BIDRAWN (ABOVE AND INSET)



OLDSMOBILE INTRIGUE GL



PORSCHE BOXSTER

Gone are the bloated, cushy automotive dinosaurs from Oldsmobile's past. In their place is a solid lineup of thoroughly contemporary, extraordinarily capable cars. Today's Oldsmobile is typified by our newest long-term test car, a black-with-tan-leather Intrigue GL.

Test Summary: Oldsmobile Intrigue GL
Report number: 1
Base price: $22,100
As-tested price: $24,370
Extra-cost options: Leather-trimmed seating areas, Autobahn package, AM/FM/CD/cassette with steering wheel controls, NY/MA/CT emission controls
Drivetrain: 3.8-liter V6 engine, 4-speed automatic transmission, front-wheel drive
Engine performance: 195 hp/220 ft.-lb.
EPA fuel economy: 19 city/30 hwy.

It has already collected enough break-in miles to be headed for its first service. And no wonder. With the optional Autobahn package we ordered, our Intrigue handles like a European thoroughbred costing tens of thousands more. Forget anything you've heard about Oldsmobiles in the past 10 years. This Olds feels like a sports car with four doors. It has already become a staff favorite.

With a price of less than $25,000, a CD/cassette sound system, dual-zone automatic climate control, and traction control, how could it not? We'll let you know if the Intrigue can live up to the standards set by big brother Aurora. —*D.C.*

Chevrolet Venture LS

After GM entered the front-drive mainstream minivan market with its controversial plastic-bodied, scoop-snouted trio, many folks wondered what the GM product planners and designers had in their morning coffee. As Chrysler Corp. continued to collect a full half of all the money being spent on mini-

Test Summary: Chevrolet Venture LS
Report number: 1
Base price: $22,259
As-tested price: $27,685
Extra-cost options: Front and rear a/c, 7-passenger rear bucket seats, integrated child safety seat, power sliding passenger-side door, sports suspension, traction control, theft-deterrent system, rear-seat audio, AM/FM/CD/cassette, trailering package, LS preferred equipment
Drivetrain: 3.4-liter V6 engine, 4-speed automatic transmission, front-wheel drive
Engine performance: 180 hp/205 ft.-lb.
EPA fuel economy: 18 city/25 hwy.

CHEVROLET VENTURE LS

PHOTO BY GREG JAREM

MERCEDES-BENZ E420

vans, those planners and designers decided that the radical course may not have been the best direction to take in the minivan market segment. Now we have a trio of superb, mainstream and eminently enjoyable minivans from the General. The most popular of that trio, naturally, is the one with the bow tie on its nose, the Venture.

So we ordered a Venture, in LS trim and dark blue paint. Naturally, we opted for four doors, like most everyone buying a minivan is doing these days. That means the sliding passenger-side door is power operated. In the quest for break-in mileage, our Venture has already been back and forth between New York, Detroit and Cincinnati, carrying assorted people, furniture and motorcycles. —*D.C.*

Test Summary: Mercedes-Benz E420
Report number: 4
Total miles driven: 27,558
Miles driven since last report: 6076
Average fuel economy: 19.8 mpg
Worst observed fuel economy: 15.6 mpg
Best observed fuel economy: 22.5 mpg
Maintenance/repair costs: Scheduled 21,000-mile service, $260.22

Mercedes-Benz E420

How would you like to have the numbing task of running a Mercedes-Benz E420 Sport for the last three months of its long-term test for a major consumer magazine, all the while trying to find faults so you have something to write about? Hey, think this job is easy?

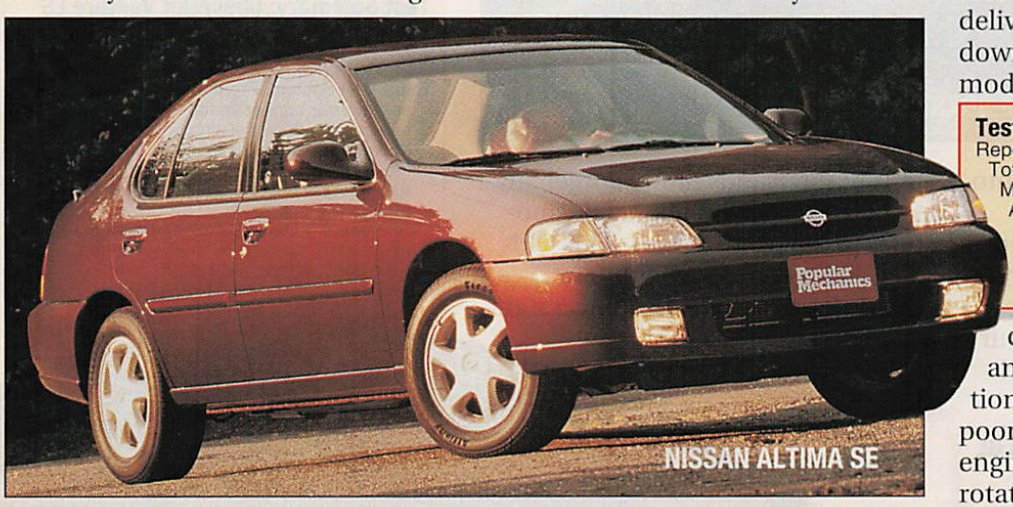
The trouble is, we never found anything to dislike other than the switch for the ESP stability and traction control. This is positioned directly in front of the switch for the driver's window and both switches are identical. So many's the time we defeated the ESP leaving tollbooths with our window open.

Even with the traction and stability control, we ordered a set of low-profile high-performance snow tires from our friends at Michelin to help get the Benz through the winter. Ironically, we've had one of the mildest winters in a long time, with practically no snow, thanks to El Niño. Luckily those fat Michelins work great on dry pavement as well as in snow.

Otherwise, this car is as tight and solid at over 27,000 miles as it was the day it rolled off the assembly line in Sindelfingen. The power from the V8 rolls like thunder through your right foot. The 5-speed automatic shifts like a stick. The handling is tight and responsive. The car is, simply, a pleasure.

Behind the wheel of an E420 Sport, the commuting process becomes as close to sheer delight as a drive on the New Jersey Turnpike and through the Lincoln Tunnel can be. Leave the office about 7 pm. Collect the Benz in the garage. Heater and seat heater on. Sunroof open. Light up an Arturo Fuente Double Chateau. The drive home won't be that bad after all.

—*Joe Oldham*



NISSAN ALTIMA SE

Nissan Altima SE

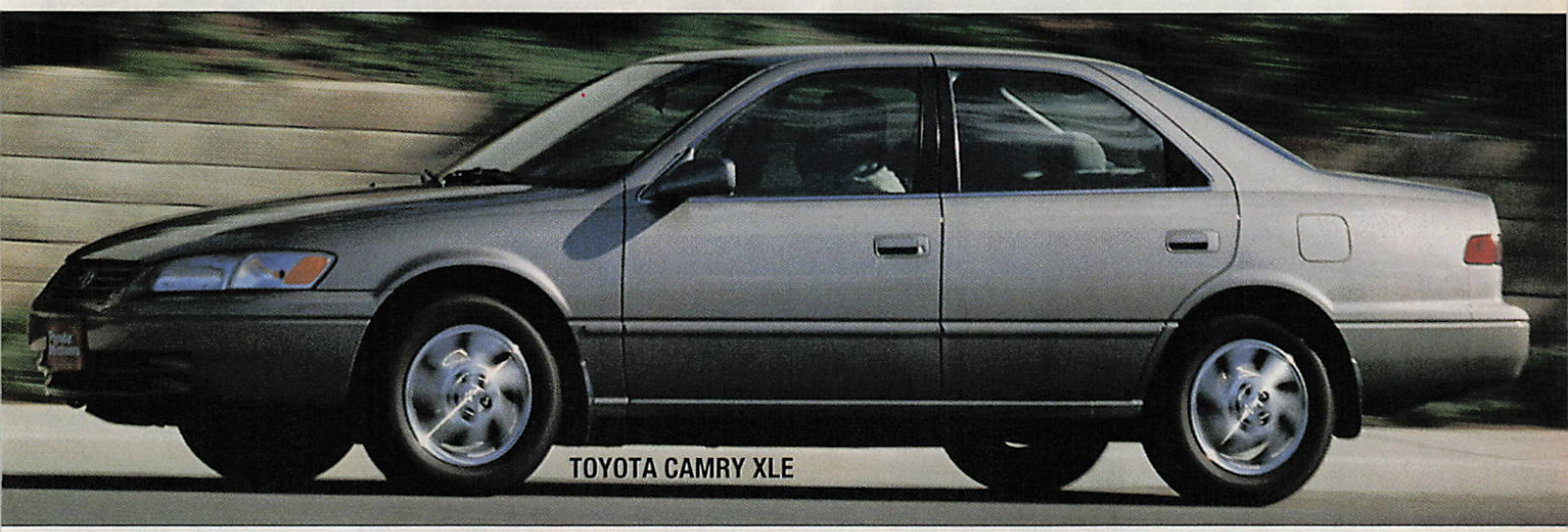
Unassuming and contemporary, our Altima is extremely adequate on all counts so far. Strong points include a cavernous trunk and a seemingly bottomless gas tank. It delivers excellent mileage. The downside to the excellent mileage is modest performance. The engine is quiet and smooth at cruise, but any attempt at vigorous acceleration results in a couple of abrupt, poorly managed downshifts, a lot of engine noise and a sluggish upward rotation of the speedo needle. In spite of this complaint, our Altima has accumulated a lot of mileage in just a few months.

Test Summary: Nissan Altima SE
Report number: 2
Total miles driven: 14,338
Miles driven since last report: 11,474
Average fuel economy: 23.5 mpg
Worst observed fuel economy: 20.0 mpg
Best observed fuel economy: 29.1 mpg
Maintenance/repair costs: Scheduled 7500-mile service, $89.42

Our Altima has had a relatively uneventful tenure in the fleet, punctuated by several trips to the dealer. First was a normal 7500-mile service done at Santa Monica Nissan for what we deemed an appropriate $89.42. Next, a mysterious crack in the windshield resulted in a new windshield, which was covered by warranty and replaced for free. Fi-

PHOTOS BY LES BIDRAWN (TOP), GREG JAREM (BOTTOM)

With the optional Autobahn package, our Intrigue handles like a European thoroughbred costing tens of thousands more.



TOYOTA CAMRY XLE

nally, El Niño rains seem to annoy the alarm system, triggering it regularly at dark-oh-thirty am. Nissan technicians haven't yet found a solution except parking indoors.

—Mike Allen

Test Summary: Toyota Camry XLE
Report number: 2
Total miles driven: 22,488
Miles driven since last report: 22,150
Average fuel economy: 25.9 mpg
Worst observed fuel economy: 18.4 mpg
Best observed fuel economy: 32.4 mpg
Maintenance/repair costs: Scheduled 7500-mile service, $62.54; 15,000-mile service, $108.60; replacement windshield, $464.95

Toyota Camry XLE

Well, so far it's not as perfect as we had hoped, but it's pretty damn close. With this car's legendary reputation for quality, we expected perfection. But after more than 22,000 miles in less than six months, our beige V6 Camry has had a few little annoying things go wrong, just like most other cars. Our car was delivered with part of the rubber molding surrounding the driver's door sticking up like Alfalfa's hair, a sticking gas-filler door and a cruise control that picks up speed.

Soon after a cross-country drive from the New Jersey shore to the land of "Baywatch," the Camry was ready for its 15,000-mile service, and a few more minor fix-its: The button on the seatbelt that keeps the buckle from falling to the floor disintegrated, the driver's seat was rocking in its mounts, and—through no fault of the car—the windshield needed replacing, thanks to a chunk of Tennessee roadway and an 18-wheeler. Both the seatbelt and the seat mount had to be ordered. The cruise control, which is still gaining 2 to 3 mph with every incline, has been deemed "fine" by two different dealerships. Otherwise, our Camry is performing beautifully. It's remarkably comfortable and ideal for state-to-state cruising.

—Scott Oldham

CHEVROLET MALIBU LS

Chevrolet Malibu LS

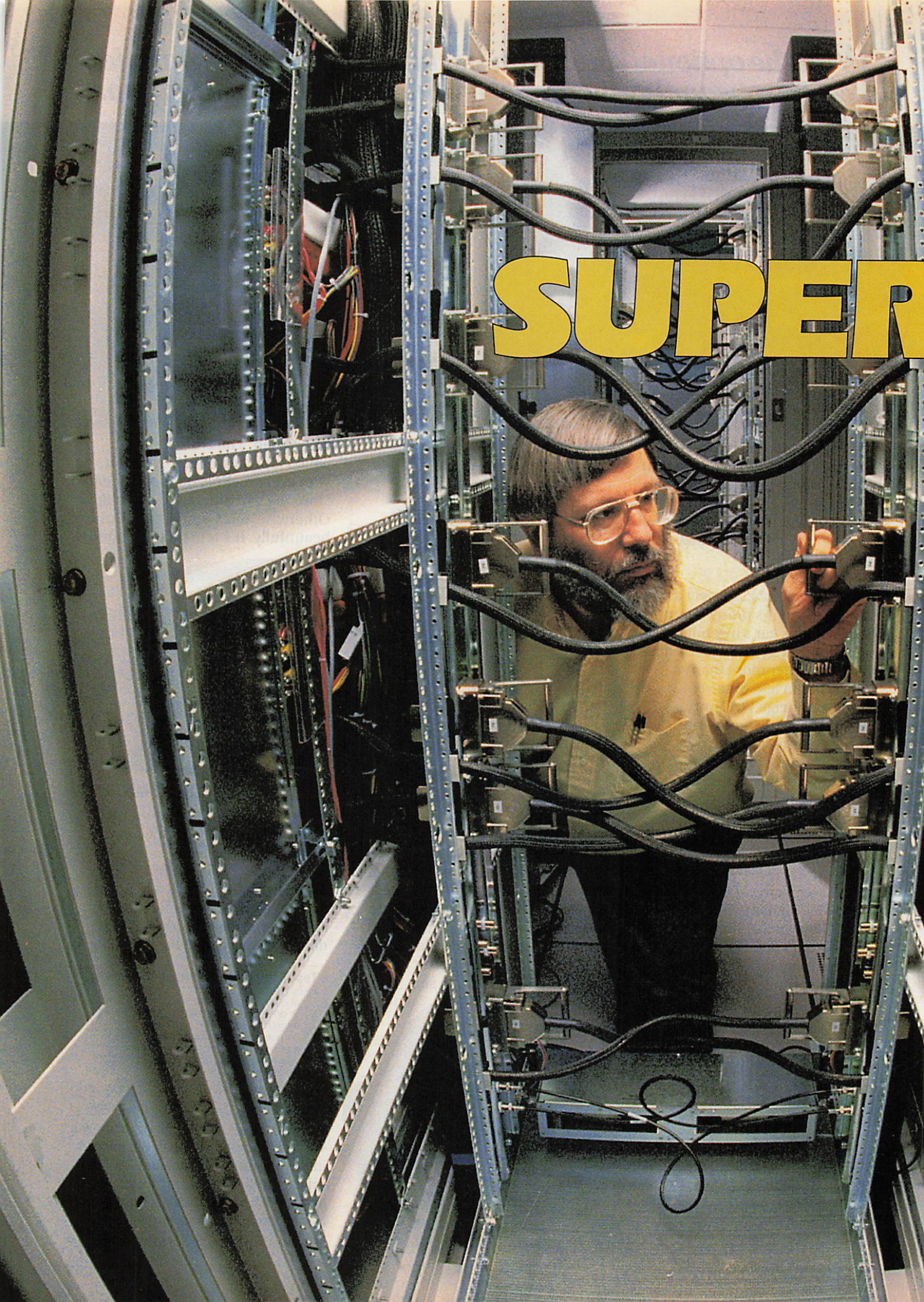
After 9550 miles of mixed highway and city driving, our earlier doubts about performance, ride and handling are erased. In fact, the Malibu is almost fun to drive. A few bedeviling problems did crop up. Right from the 4000-mile mark a squeak developed in the left front suspension. By 9000 miles, the squeak became a creak, and we scheduled a dealer call. But right then the squeak-creak stopped.

Test Summary: Chevrolet Malibu LS
Report number: 2
Total miles driven: 9950
Miles driven since last report: 9350
Average fuel economy: 24.3 mpg
Worst observed fuel economy: 21.5 mpg
Best observed fuel economy: 26.6 mpg
Maintenance/repair costs: Scheduled 5000-mile service, $38.56

CADILLAC CATERA

(Please turn to page 139)

PHOTOS BY BILL DELANEY (TOP); GREG JAREM (CENTER AND BOTTOM)


SUPER

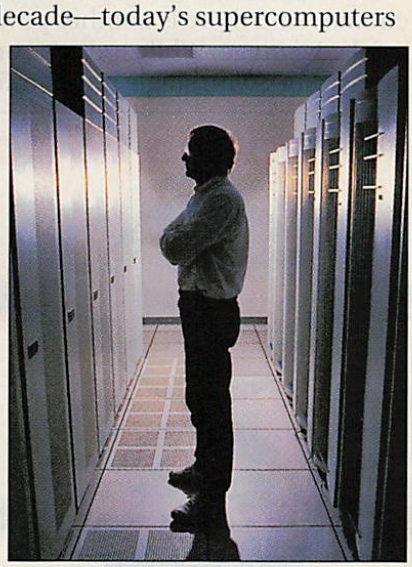
SIZZLING COMPUTERS

Computers that calculate with light, the quirky laws of quantum mechanics and DNA will soon leave silicon in the dust.

BY MIKE FILLON

The team from Sandia National Laboratories and Intel Corp. barely had time to congratulate themselves after their Tflops supercomputer burst through the seemingly impossible speed barrier of 1.3 trillion calculations per second. Their friendly competitors at Cray Research quickly announced their supercomputer had duplicated the feat. Breathtaking as the achievement is—it represents a 1000-fold increase in computing speeds in less than a decade—today's supercomputers will seem as sluggish as slide rules when compared to the high-performance machines computer scientists now have on their lab benches.

COMPUTERS



Banks of silicon chips forming Sandia's Tflops (above and left) represent today's supercomputing technology.

The speed barrier researchers are racing to break through isn't caused by any design limitation of today's machines, but by the materials used in computer circuits. Tflops, for example, consists of 76 large cabinets (left) sprawling over 1600 sq. ft. Inside these cabinets are 9072 Pentium Pro processors. The consensus among industry experts is that this sort of silicon-based technology will hit the wall sometime between 2010 to 2015. By then, semiconductors will probably be only a few molecules thick, but even at this diminutive size they won't be up to the number-crunching needed, say, to model the atmosphere for long-range weather forecasting.

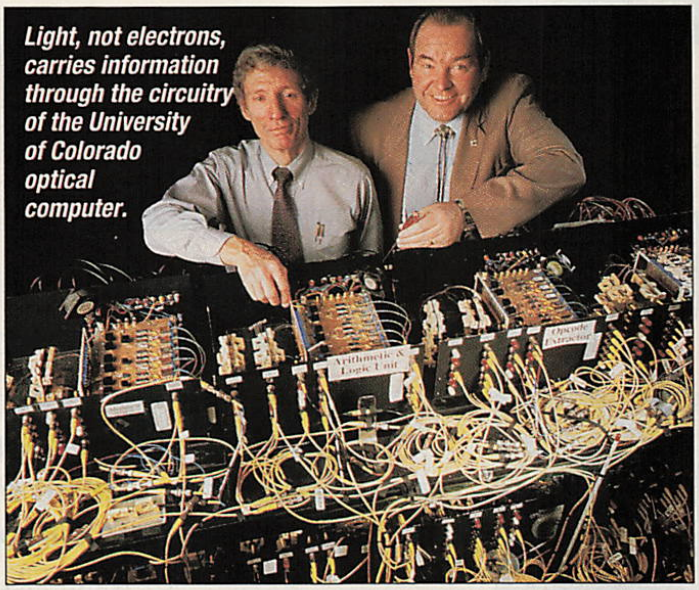
Three new technologies are in the running to replace silicon-based supercomputing. One of the new classes of machines—the optical computer—uses light in place of circulating electrons, eliminating heating problems and the bottlenecks that develop at metallic connections. The second class of machines, called quantum computers, finds answers by taking advantage of a quirky law of quantum mechanics that says, in effect: Until someone peeks at

PHOTOS BY SANDIA NATIONAL LABORATORIES/RANDY MONTOYA

Optical computers will be able to process billions of bits of data at the same time.

it, a subatomic particle can be everywhere at once. The third, and perhaps strangest, type will use biological materials in place of silicon. These so-called DNA computers will solve problems by following the same rules living organisms obey to pass genetic information from generation to generation.

Here's a closer look at what's ahead.



Light, not electrons, carries information through the circuitry of the University of Colorado optical computer.

Optical Computers

Although they are small, electrons still have mass. This limits the speeds they can attain, and causes them to generate heat as they travel through materials. This leads to problems in the aluminum, copper and—someday—carbon connections inside and between silicon-based components.

Optical computers will be faster because light moves through space and fiberoptic cable quicker than electrons do through silicon-based circuits. And there is another powerful advantage. While today's computers work with single bits of information, optical computers will be able to process billions of bits at the same time. This will result in a huge increase in computing speed.

Most of the fundamental technological problems have been solved. At Columbia University, in New York City, researchers have combined transistors and lasers in a new microchip they hope will simplify fiberoptic communications. The technology may also lead to the development of such miniaturized optical devices as tiny lasers and implantable medical sensors.

"Ultimately, manufacturers will be able to combine optical and electronic capacity on the same silicon crystals," predicts Richard Osgood, co-author of the research. This work should result in superior electronic platforms.

Optical computers could be the first of the new designs to move into the marketplace, perhaps within a decade.

Already, Kristina Johnson, a computer scientist at the University of Colorado, in Boulder, has designed an optical processor that can identify cancer cells on a pap smear in a fraction of the time it takes a conventional computer to do the job.

The problems that remain are chiefly engineering hurdles, such as learning how to make lasers, lenses, and mirrors that are cheap, small and reliable enough to be used in commercial systems.

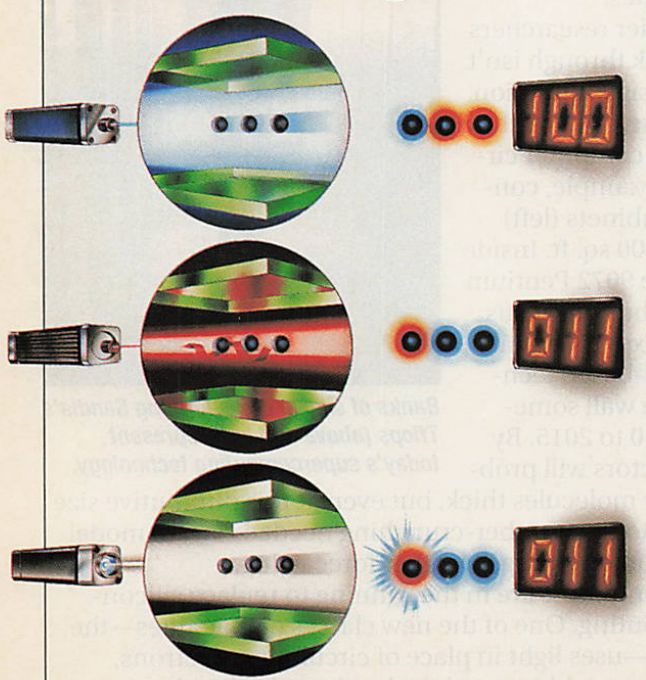
Quantum Computers

Scientists have been toying with the idea of quantum computers since the early 1980s, but only recently have they started taking them seriously.

Combining conventional information theory and quantum mechanics, "quantum computing" is beginning to tantalize theorists with the prospect of breaking through barriers that may be insurmountable with current technology.

Although no physical method of realizing a complete quantum computer has yet been found, scientists have worked out the details of building components such as the NOT gate, shown at the left. Here, a characteristic of atoms referred to as "spin" represents the binary 1 or 0. Although the technical obstacles are daunting, progress is being made on several fronts. Researchers at the National Institute of Standards and Technology, in Boulder, Colorado, have demonstrated that they can trap a beryllium ion electromagnetically. Laser pulses (left top) cool the ions. Then, when a combination of fast laser pulses excites the ion, it fluoresces, emitting photons (left bottom). Lasers can also be used to change information stored as ions. In the quantum NOT gate (left center), another laser pulse causes the spin of each ion to change. This has the same effect as performing what mathematicians call a Boolean Negation, a fundamental operation for all computers.

Quantum Logic

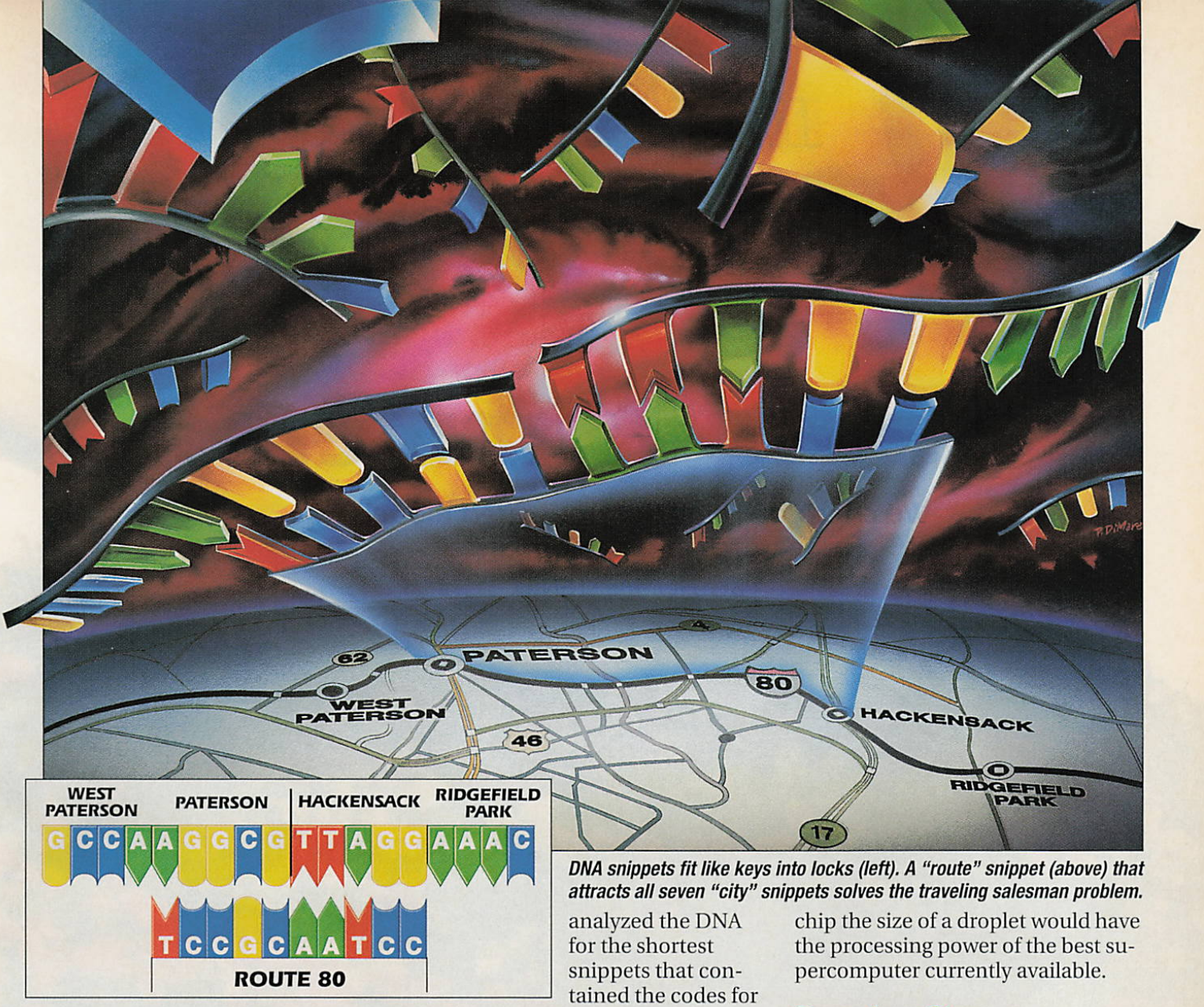


An ion's "spin" represents a 1 or 0. Laser-cooled ions store data (top). Laser activation can alter data (center) or make it readable by causing Os to fluoresce (bottom).

DNA Computers

In the early 1990s, mathematician and biologist Leonard Adelman became fascinated by the parallels he saw between genes and com-

ILLUSTRATIONS BY PAUL DIMARE; PHOTO BY J. MARTIN NATVIG/UNIVERSITY OF COLORADO-BOULDER



DNA snippets fit like keys into locks (left). A "route" snippet (above) that attracts all seven "city" snippets solves the traveling salesman problem.

puter technology. While computers manipulate data as strings of zeros and ones, he noted, genes consist of information encoded as strings of the four nucleotides that make up DNA: adenine, cytosine, guanine and thymine.

Adelman decided to test his prototype of a DNA computer using the mathematical challenge known as the "traveling salesman" problem: How can you visit seven cities connected by 14 roads without passing through the same city twice?

Adelman assigned a code for each city and each road. He then mixed snippets of DNA in solution and allowed them to react. The four nucleotides combine according to a hard and fast rule called complementary base pairing—guanine (G) binds to cytosine (C), and adenine (A) to thymine (T). The snippets fit together like a line of overlapping Lego blocks (above).

To find the answer to the traveling salesman problem, Adelman analyzed the DNA for the shortest snippets that contained the codes for each intermediate city, without repetitions. Adelman noted that the DNA computer solved the problem faster than any conventional computing device—on the first try.

Researchers at the University of Rochester, in New York, have taken a first step at incorporating organic components into computers by creating DNA logic gates. Electronic computers use logic gates to convert binary data into meaningful signals for performing operations. The DNA logic gates detect specific fragments of genetic blueprint as input and splice these together to form output.

The DNA structures are created using common laboratory techniques, say Animesh Ray, an assistant professor of biology at Rochester, and Mitsu Ogihara, an assistant professor of computer science. The researchers note that one pound of DNA can store more information than all the electronic computers ever built, and that a DNA chip the size of a droplet would have the processing power of the best supercomputer currently available.

Running Strong

Some argue that despite the obvious advantages they offer, the new supercomputer technologies will not replace silicon entirely. The skeptics point out that there are plenty of computer applications—such as word processing programs—that don't require the raw power these new machines will bring to the game. They also suggest that businesses that have multibillion-dollar investments in silicon-based machines won't be eager to jump to a new technology, even if it does offer monumental increases in speed.

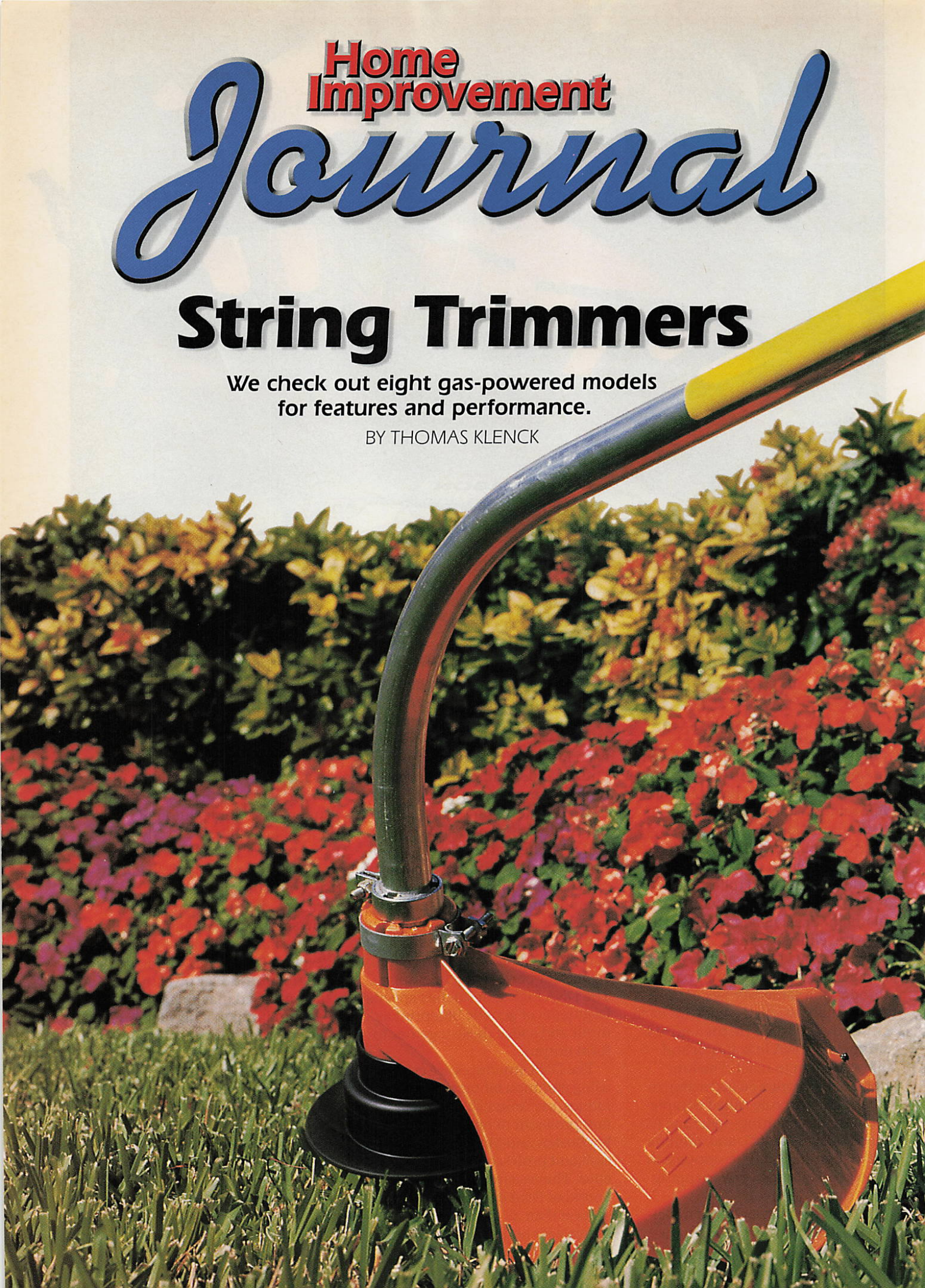
These arguments have merit. But they don't alter the fact that sooner or later the physical limits of pushing electrons through silicon, carbon and metal will be reached. We'll have to hit the RESET button and adopt entirely new technologies—or else give up on solving problems that only the most powerful supercomputers can tackle. **PM**

Home Improvement Journal

String Trimmers

We check out eight gas-powered models for features and performance.

BY THOMAS KLENCK



Walk through any well-kept community and you can pick out the people who don't own and use string trimmers—they're either on their knees using grass shears, or off playing golf while they finance their gardeners' next winter vacation. And then there are those who blissfully ignore any area the lawnmower won't reach, preferring the casual look in landscape design.

The truth is, the string trimmer is a piece of equipment that solves a common landscape maintenance problem exceedingly well, and does it in a way that no other tool can duplicate. It cuts grass, weeds and light vegetation with a vengeance, while leaving just about everything else unscathed. It is, in fact, a selective lawnmower. It cuts right up to, and under, a picket fence, or around a boulder that would spell disaster for a mower blade. The trick is in the cutter. It's not metal, like most other tools. It's nylon string.

COMPARISON TEST

So, how does a piece of limp nylon tear through a hayfield? The answer is that it's not really limp—at least while it's working. The business end of every trimmer has a spool from which two strings extend. When the spool spins, centrifugal force pulls the strings away from the center and stretches them tight. The result is a pair of fairly stiff pieces of line whipping around somewhere over 7000 times each minute.

The beauty of the system is that while the spinning string is no longer limp, it isn't exactly rigid, either. It still retains enough pliability to bounce off things like fences, tree trunks and stone walls, while experiencing only marginal wear and tear.

Drive Types

All string trimmers feature a long shaft that connects the power supply, either a gas engine or an electric motor, to the spool of string. Along the way, you'll find a handle, motor controls and perhaps a shoulder strap, if the unit is heavy.

Within these constraints, designers offer us two basic types of trimmers—bent-shaft and straight-shaft models. While the professional landscaping community favors the straight-shaft design, bent-shaft trimmers are generally easier to handle with little, if any, loss in performance. Straight-shaft adherents claim that their tool has a greater reach and easily slips under things like picnic tables and decks. While we found this to be true, the bulk of your trimming work will be right in front of your feet. Plus, a bent shaft orients the spool so it's level with the ground—the best position to avoid scalping the lawn. Mechanically, the issue is one of a bent, flexible drive cable versus a straight driveshaft that delivers power through a gearbox above the trimmer spool. The bent cable is lighter and more direct, but necessarily flexes as it drives the spool. While we were unable to test either design until drive failure, it pays to note that—bent shaft or straight—manufacturers typically offer a

PHOTO BY J. BRIAN KING

two-year warranty. And, except for the McCulloch trimmer we tried (see "The Heavy-Duty Difference" below), all of the straight-shaft trimmers we tested used flexible cable to transmit power to the cutterhead.

Most trimmers have a centrifugal clutch that connects the engine to the driveshaft. The clutch disengages the spool at idle speed, but spins it as rpms increase. The only trimmer in our group without a clutch is the Weed Eater XT-600.

Powerheads

All the models we tested had 2-cycle engines except the Ryobi 975r. In fact, Ryobi has cornered the market on 4-cycle trimmers—if you hate measuring and mixing oil, Ryobi has the answer.

Trimmer engines are rated in terms of engine displacement, and you'll find models ranging from about 20cc to over 35cc. While engine size and weight can affect ease of use, more important is the handle design and whether you need a shoulder strap. Light units with a simple bail-type handle and no strap are the easiest to maneuver. J-handles add extra leverage and heavy-duty trimmers often have U-shaped handles and shoulder harnesses to offset weight and increase maneuverability.

Most trimmer engines have similar controls—the differences lie in accessibility and ergonomics. Carburetor features include a primer bulb that pumps gasoline from the tank for cold starts, adjustment screws for high speed and idle, and a choke (Photo 1, page 109). While most makers use a carburetor-mounted lever for the choke control, Stihl employs a large dial (Photo 2).

Like chain saws, trimmers are generally run wide open—the throttle is more an ON/OFF switch than a variable-speed control. Makers all place the throttle on the shaft handle so it can be held open for use. While some trimmers have their ignition switch by the engine, the more convenient designs have it near the throttle (Photo 3).

All of the trimmers we tested, except the Stihl model, feature a see-through gas tank for checking the fuel level. Weed Eater and Husqvarna add a handy tether to the gas cap so it won't be misplaced (Photo 4).

At The Spool

In normal use, you can expect the nylon string to fray at the edges and become shorter. To maintain performance, most of the trimmers we tested have a semi-automatic line feed system to refresh the cutting edges. Simply tapping the bottom of the spool on the ground temporarily frees the spool from the driveshaft to allow some line to unwind. A blade at the edge of the guard cuts the line to length. When you finally run out of string, it's time to rewind the spool. The Ryobi and Sears models we tested have wind-on spools that don't need to be disassembled for loading new string (Photo 5). The cutterhead on the new Homelite VersaTool (see "New This Year" sidebar, page 109) holds a short length of string that's replaced when it's worn.

A typical trimmer spool contains two lengths of string (or one length doubled), and the ends exit through

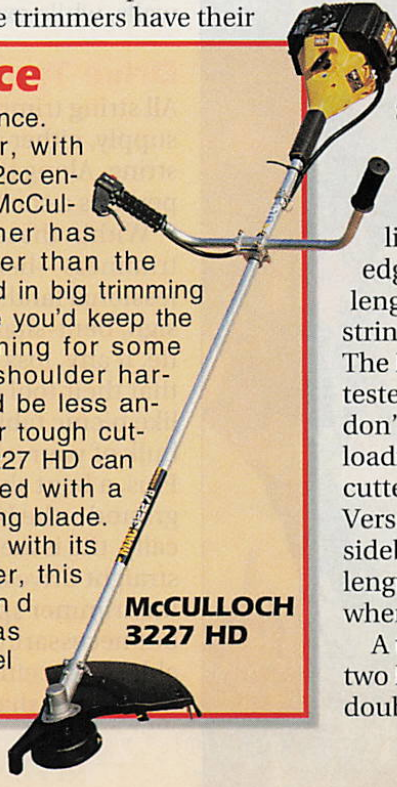
The Heavy-Duty Difference

Manufacturers know that some folks want more than a basic, light-duty trimmer. To get an idea how the heavier units compare, we tried out the McCulloch 3227 HD (about $200).

Some of the differences are obvious. For example, the wide U-handle makes it easy to lever the trimmer around a cutting area and keep the cutting head level.

However, with a hand at each end of the handle, a shoulder harness is an absolute necessity—your hands only direct the cutterhead, they're not in any position to support the machine as they would with a lighter unit. And starting the trimmer means unhooking the harness, then rehooking it for operation. We feel that for average work the U-handle and shoulder harness are a nuisance.

However, with its ample 32cc engine, this McCulloch trimmer has more power than the others. And in big trimming jobs, where you'd keep the motor running for some time, the shoulder harness would be less annoying. For tough cutting, the 3227 HD can be equipped with a brush-cutting blade. In keeping with its extra power, this 15-pound trimmer has a solid steel driveshaft.



opposite holes on the spool casing. In a single-reel spool, both lengths are wound together. If these lengths become entangled, the semiautomatic feed system may not work properly. To remedy this problem, most of our test models have a 2-reel spool where the lines are kept apart (see illustration, page 108).

While string trimmers excel at cutting around obstacles, you may run into trouble cutting dense, high growth. Depending upon the trimming-head design, you can expect tall weeds to wind up around the spool to a greater or lesser degree. In some cases, the snarl of weeds is enough to slow or stall the engine. In general, trimmers with a gap between the spool and the end of the shaft are more prone to weed snarl (Photo 6). All of our test trimmers use .080-in.-dia. line, except the Homelite VersaTool which uses .105-in. line.

Echo GT-2000

While the bent-shaft Echo entry has the smallest engine in our group, its performance didn't seem to suffer. This trimmer was the lightest tool we tested—if it did cut less aggressively than some of the others, effortless handling more than made up for it.

Without the sleek housing that many other trimmers sport, the Echo's components are readily accessible and carburetor adjustments are easy to reach. The gas tank has a large cap for easy filling and the engine-mounted ignition switch is of the no-nonsense toggle type.

On our needs-improvement list, we'd ask for a somewhat better score on the noise-level test. And, at the spool, this trimmer tended to bind up with wound grass when the going got rough and heavy. Instead of the threaded cap that holds the spool assembly together on the Ryobi, Sears and Stihl models, Echo uses a handy snap-on mechanism.

Husqvarna Mondo MAX

With its macho-sounding name and sleek purple housing, this trimmer almost seems more like a fashion accessory than a landscaping tool—especially when placed next to the tough little Echo unit. Fortunately, the frills are only skin-deep. The Husqvarna started up on the first pull and showed good, snarl-free power at the cutting end.

Under the hood, we couldn't help noticing mechanical similarities between this tool and the Weed Eater XT-600. The differences include the Husqvarna's longer shaft, more convenient handle-mounted ignition switch, and oversize starter-cord handle and choke lever.

Other features include a gas cap that's tethered to the tank, and a wingnut on the bail-type handle for easy adjustment in the field, and a snap-on spool. Our tests place the Husqvarna at the low end of the noisemakers, while its 55-in.-long straight shaft gives it impressive ground-covering reach.

Ryobi 975r

The Ryobi trimmer has the only 4-cycle engine in our group and boasts relatively low exhaust emissions as a result of eliminating the oil mix. For versatility, the tool's shaft splits at the midpoint to accept accessories. These include a cultivator, edger, vacuum, blower, pruner and even a snowthrower. In terms of performance, the 975r knocks down weeds with the best of them.

Ryobi's 4-cycle powerplant was one of the quietest. With no oil mix to worry about, fueling up is a breeze, but you still have to check the oil and change it regularly.

Unlike most of the other machines

SPECIFICATIONS

MANUFACTURER/ MODEL	PRICE[1]	CUTTING SWATH	DISPLACEMENT (CC)	WEIGHT (LBS.)	SHAFT TYPE	SHAFT LENGTH	NOISE[2] (IDLE)	NOISE[2] (MAX)	SPOOL TYPE
Echo GT-2000	$160	16"	21.2	9.3	Bent	48"	77	92	Single
Husqvarna Mondo MAX	$180	17"	24.0	12.5	Straight	55"	72	88	Double
Ryobi 975r	$180	16"	26.2	13.8	Straight[3]	49"	70	88	Double[4]
Sears 79511	$180	18"	23.0	10.0	Straight	55"	77	92	Double[4]
Stihl FS 36	$140	16"	30.2	10.8	Bent	48"	72	90	Double
Weed Eater XT-600	$110	17"	24.0	12.5	Straight	50"	73	90	Double

1. Approximate selling price as estimated by the manufacturer; prices may vary. 2. Sound level as measured on dBA scale. 3. Shaft splits at midpoint for accessory installation. 4. Wind-on spool.

PHOTOS BY THOMAS KLENCK

in our group, the 975r comes with a J-handle and strap. Considering that this is one of the heavier tools, both features are welcome. All of the controls are conveniently designed and positioned, and the throttle and handle-mounted ignition switch are particularly well designed.

At the cutting end, Ryobi uses a novel spool that can be wound with new string without removing the inner reel. About the only downside to this tool is its weight. And, the split-boom shaft is a little shorter than the other single-purpose straight-shaft tools we tested.

Sears 79511

If the bare-bones feistiness of the Echo appeals to you, but you prefer a straight shaft, you'll probably be happy with the Sears. We found this model very aggressive and, at only 10 pounds, a breeze to handle.

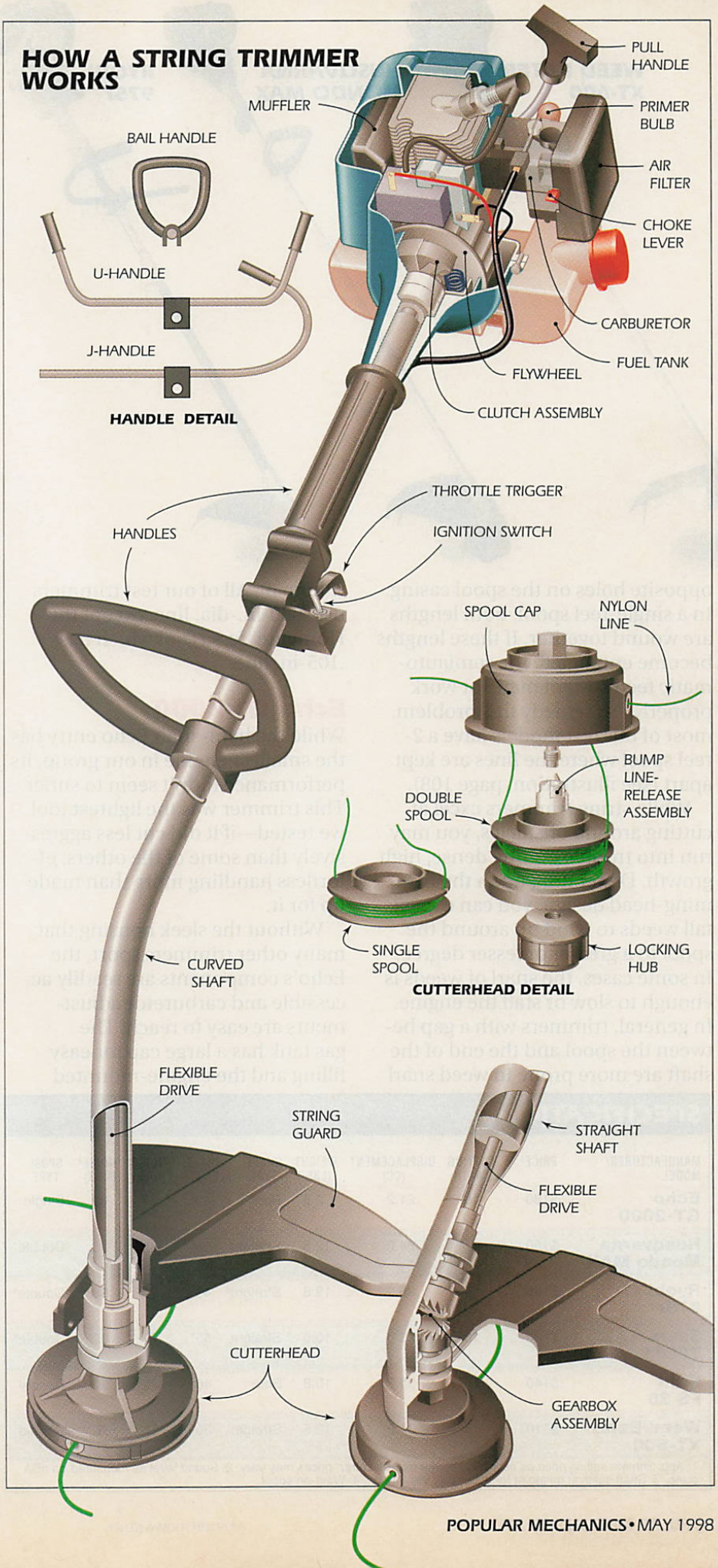
Like the Echo, the Sears 79511 has a toggle-type ignition switch, only Sears has thoughtfully mounted it on the shaft handle near the throttle. The throttle and switch are not as nicely designed as the ones on the Ryobi but at least they're together. The choke lever is small and the priming bulb is a little out of the way. Noticeably absent are the idle and high-speed mixture adjustment screws that all of the other trimmers have.

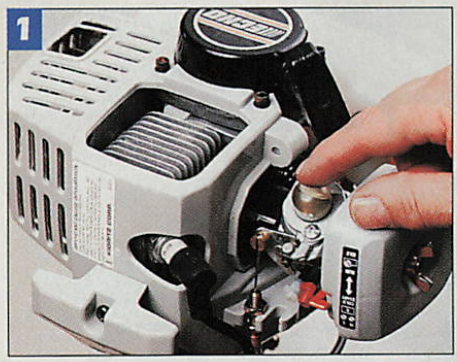
Sears uses the same spool as the one on the Ryobi, with a string wind-on feature that doesn't require spool disassembly. Along with Husqvarna, Sears claims the long-reach contest with a 55-in. shaft. Along with the Echo, this trimmer is the leader in noise pollution—our measurements of idle and maximum noise average at 84.5 dBA.

Stihl FS 36

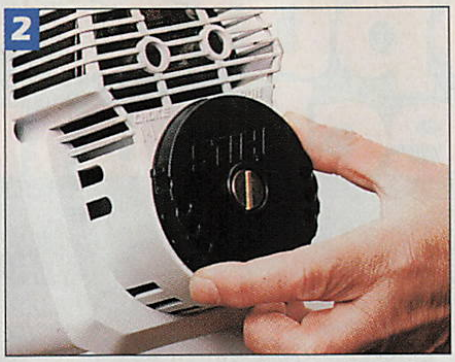
Unlike the other trimmers that sometimes seem as if they've been assembled from off-the-shelf components, this model appears designed from the ground up. It boasts a novel engine housing that hides an ample 30.2cc powerplant, but its most unusual feature is the large dial at the back that serves both as a choke control and air-filter cover.

Appearances aside, this trimmer is a comfortable, easy-to-handle



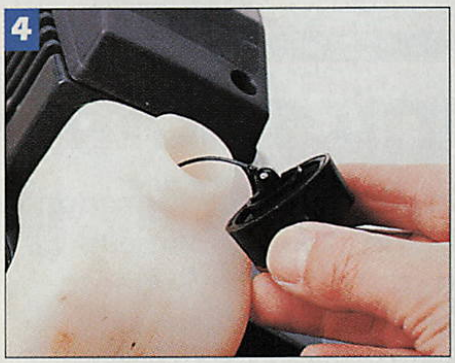


Carburetor controls on the Echo are easily accessible. The primer bulb pumps gas from the tank for cold starts.

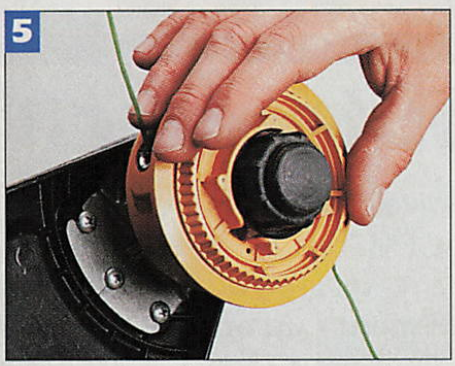


The unique Stihl engine housing includes a large dial that covers the air cleaner and acts as a choke control.

Ryobi's ergonomic shaft handle incorporates a throttle trigger (bottom) and a sliding ignition switch (top).



Husqvarna and Weed Eater trimmers both feature a gas cap tethered to the tank so it can't get lost.



Nylon cutting line can be wound onto Ryobi and Sears trimmers without disassembling the spool.

The gap between spool and shaft on the Weed Eater invites snarling. The Stihl (below) is nearly snarl-free.

PHOTOS BY THOMAS KLENCK

piece of equipment. Cushioning on the handles reduces vibration and the controls are large and easy to operate. We felt that the FS 36 had good power and the tool seems well balanced at a modest 10.8 pounds.

Due to a novel cutterhead design that fits around the string shield, the Stihl unit was very resistant to weed tangles and snarls—a feature that made it stand out in heavy use.

Weed Eater XT-600

While this trimmer bears a familial resemblance to the Husqvarna entry, the XT-600's features put it in a class of its own.

On all other trimmers, starting the engine requires that the ignition switch be turned on. Weed Eater has managed to simplify this already basic step with a rocker-type ignition switch that's always on—you only use it to shut down the engine. Although the shaft is 5 in. shorter than the Husqvarna, it has the same handy snap-on spool. We found that the XT-600 was somewhat prone to weed snarls and wound-up grass due to the space between the cutterhead and gear housing. As mentioned above, the Weed Eater is the only machine in our group with no clutch. At idle, the spool spins along with the motor—not fast, but it's something to be aware of.

Our Picks

For typical around-the-house and yard use, we favor the bent-shaft design. Of the two we tested, the Stihl has the edge in terms of power, price and design. However, if weight is a priority, the Echo nudges ahead.

If you want a straight-shaft model, the Husqvarna and Sears are two good choices. And, although the Ryobi is a fine trimmer, it sacrifices reach and light weight for 4-cycle convenience and snap-on accessories. The Weed Eater is the economy model in this selection. If you can live without a clutch and can avoid heavy, tall grass, it works just fine. PM

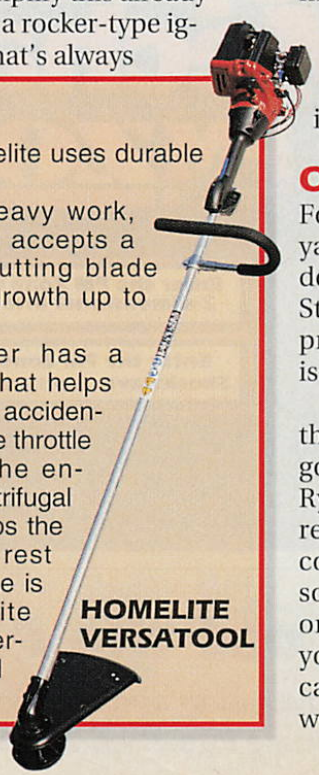
New This Year

If you're looking for the latest in string trimmers, Homelite has something to offer. While the model we tried was not in full production at the time of our test, it has several features that set it apart from the other tools in this price range.

Homelite calls this straight-shaft string trimmer the VersaTool. It boasts a wide-ranging 54-in.-long shaft and a cutterhead designed to plow a 17-in.-wide swath. Instead of the usual string spool, Homelite's Pro Cut head uses one short length of line that extends through each side of the cutterhead assembly. When the length wears out, you simply replace it—no winding or spool disassembly to worry about. To increase the time between string changes, Homelite uses durable .105-in. line.

For extra-heavy work, the VersaTool accepts a steel brush-cutting blade that handles growth up to 1/2 in. thick.

The trimmer has a safety trigger that helps keep you from accidentally opening the throttle and revving the engine, and a centrifugal clutch that keeps the cutterhead at rest when the engine is idling. Homelite expects the VersaTool to sell for about $130.



HOMELITE VERSATOOL

PHOTO BY THOMAS KLENCK

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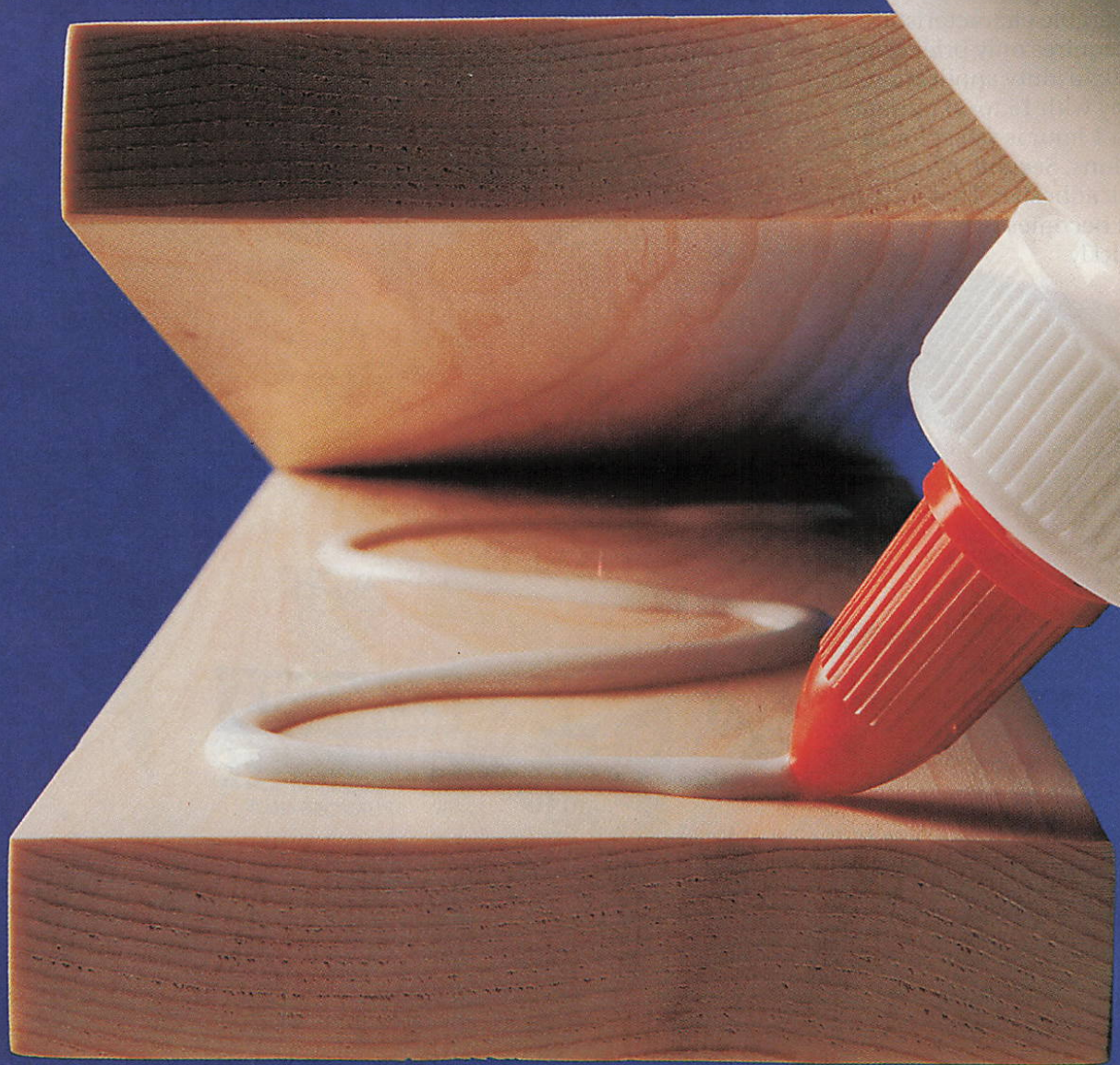
Stick Together

A basic adhesive toolkit for homeowners.

BY ROY BERENDSOHN



Let's put it this way. There are times in life when you need to be discreet. In the case of household repairs, sometimes using a fastener to hold two things together just won't do. The results will look silly, maybe even downright ugly. For instance, you wouldn't attach a loose tile by drilling a hole through it and screwing it to the bathroom wall.

CONSUMER GUIDE

Still, there are times when you could go either way. Let's say the handle breaks off the washing machine door. Sure, you can drill a hole and reattach it with a sheetmetal screw. But you also have another option: To use one of today's high-tech adhesives for a fast and discreet repair. The beauty of modern adhesives is that they make durable repairs with minimal fuss. And today's formulations are more versatile than their predecessors. As a bonus, there are single products that can do 90% of the bonding work you'll encounter around your home.

PHOTO BY BRIAN KOSOFF

Yellow Glue

Yellow glue is a more muscular version of its familiar cousin white glue. Like white glue, it bonds a variety of materials, but it's used most widely in woodworking. There are several reasons for this. First, it withstands moisture better than white glue, and outdoor formulations of yellow glue offer even more moisture resistance than interior formulations of yellow glue. As far as woodworking is concerned, yellow glue offers several other desirable characteristics. First, it requires only brief clamping. For light-duty applications you can get by with 15 to 30 minutes, although 1 hour is safest for all applications. Second, it's a high-tack adhesive. That means it becomes sticky quickly. The advantage is that shortly after applying the glue to the workpiece you can stick parts together, and they will stay in position as you place the clamps. This also reduces the tendency of the glue to run down the workpiece. The converse is also true, however. You have to work more quickly with yellow glue than with white glue.

Below, we show Titebond II, an exterior-grade yellow glue. An 8-ounce bottle costs about $3 at hardware stores and home centers. For more information, contact Franklin International, 2020 Bruck St., Columbus, OH 43207; 800-347-4583.

Plastic/Multipurpose Adhesive

3M's Super Strength Adhesive can be used on most rigid plastics, but it's also handy for bonding other materials, such as leather, glass and porcelain. It dries clear and it's formulated to be resistant to heat, oil and water. And the adhesive's 1-ounce size makes it a good candidate to keep in the kitchen drawer or carry in a toolbox. Although it

PHOTO BY ROSARIO CAPOTOSTO

sounds like it's almost identical to liquid super glue (page 116), this product has better gap-filling properties. It costs about $4 at hardware stores and home centers. Contact Product Information Source, 3M Construction and Home Improvement Markets Division, P.O. Box 33053, St. Paul, MN 55133; 800-364-3577.

Polyurethane Glue

Although there isn't a single adhesive that does everything, polyurethane glue comes pretty close. It bonds wood, many types of plastic and just about everything else. Also, it offers even greater moisture resistance than yellow glue. It's an interesting substance in that it requires moisture to cure, which means that it's good for joining wood that is not perfectly dry. It foams as it cures, making it easy to see excess glue that you can scrape or sand off.

To use it, you can lightly moisten the pieces to be joined or simply rely on the presence of moisture in the air or wood. It's a relatively slow-curing glue—you have to leave the clamps on your workpiece for at least 2 hours. On the other hand, the glue gives you 20 to 30 minutes of working time before it begins to set—a distinct advantage with difficult assemblies.

We show an 8-ounce bottle of ProBond, which costs about $10 at hardware stores and home centers. Contact Elmer's Products Inc., 180 E. Broad St., Columbus, OH 43215.

Gun-Applied Adhesives

Gun-applied adhesives come in cartridges that are inserted in a caulk gun. They are a good deal thicker and stickier than the products mentioned above. They don't require clamping pressure beyond the force required to push the parts together or that which is supplied by fasteners.

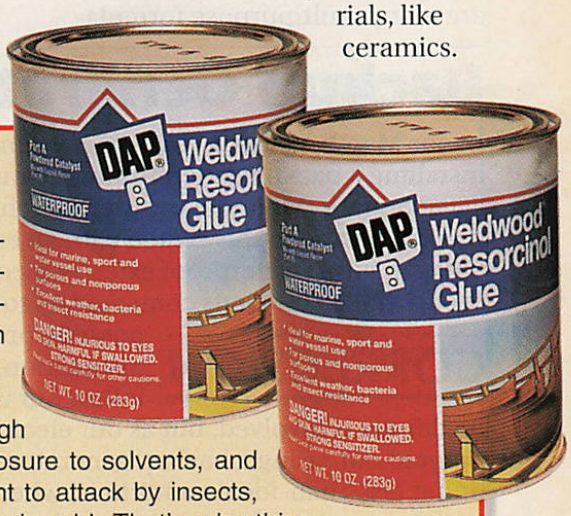
There are two broad categories of gun-applied adhesives, which are both generally used to bond multiple materials. First are the aggressive exterior, waterproof types that are used in rugged conditions. These adhesives are most widely employed to attach subfloor panels to a house's floor joists. Then there are interior adhesives formulated to meet somewhat less rugged requirements. These products are stickier than their outdoor cousins, and give you 10 to 15 minutes of working time before they begin to set.

If you're nervous about using a multipurpose adhesive, you can also get gun-applied adhesives that have been formulated for specific jobs. Large lumberyards, home centers and hardware stores often stock extensive collections of these use-specific gun-applied adhesives. There are products for wallboard, wet or frozen lumber, pressure-treated lumber, ceramic tile, vinyl and asphalt tile, masonry, plastic shower surrounds, and foam board insulation. Look no further than the cartridge for specifics about how the product is used.

We show a 10.5-ounce cartridge of Liquid Nails Heavy-Duty Construction & Remodeling Adhesive. This exterior-grade product costs about $2 at home centers and lumberyards. Contact Macco Adhesives, 925 Euclid Ave., Cleveland, OH 44115; 800-634-0015.

White Glue

White glue is the familiar, indispensable household adhesive. Its formal name is polyvinyl acetate. And, as it says on the plastic squeeze bottle, you can use it to fasten paper, fabrics, leather, wood and most porous or semiporous materials, like ceramics.



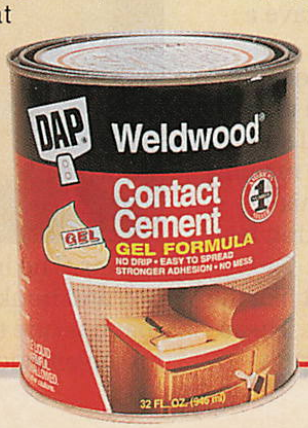
Special-Purpose Adhesives

Contact Cement

Contact cement will bond a variety of materials, but it's most widely used to attach plastic laminate to a substrate. It's easy to work with and bonds instantly—but it's very unforgiving. You don't get a second chance with this stuff. To use it, you spread a thin, even layer of cement on the mating surfaces, wait until the cement is dry to the touch and then press the pieces together. We show DAP's new gel formula. It's supposed to be easier to apply than previous products. A quart costs about $6 at hardware stores and home centers. Contact DAP, P.O. Box 277, Dayton, OH 45401; 800-327-3339.

Waterproof Glue

Other adhesives may be highly resistant to rain, snow or incidental moisture. But of the commonly available adhesives, only some forms of epoxy and resorcinol glue are completely waterproof. In other words, this glue is capable of withstanding complete and permanent submersion in fresh water or salt water. It's even tough enough to withstand exposure to solvents, and it's highly resistant to attack by insects, fungi and mold. That's why this adhesive is used in boat building and can be used to make laminated structural wood beams. Resorcinol is a 2-part formula consisting of a liquid resin and a powder catalyst. Mix the two, spread the mix on both sides of the glue joint, clamp with only light pressure, and you have an assembly joined for the ages. We show DAP Weldwood resorcinol. A 2-part quart kit costs about $23 at home centers. Contact DAP, P.O. Box 277, Dayton, OH 45401; 800-327-3339.



PHOTOS BY ROSARIO CAPOTOSTO

White glue is also low odor and cleans up with water. Under optimal conditions, it forms such a strong joint on wood that the wood will fail before the adhesive does. You can find the product anywhere from a lumberyard to the housewares section of a supermarket.

White glue has a few minor drawbacks. One is clamping time. To be sure that the glue has set, you generally have to leave the clamps on a workpiece for a couple of hours. Second, white glue isn't moisture resistant. On the other hand, it's a strong and inexpensive product. We show a 16-ounce bottle of Elmer's Glue-All that costs only $3.90 at hardware stores and home centers. Contact Elmer's Products, 180 E. Broad St., Columbus, OH 43215.

Epoxy

There was a time when epoxy was notoriously hard to work with. It was actually an industrial product designed to be used with laboratory-like precision. Homeowners who tried working with the stuff were often disappointed by the results. Today, just the opposite is true. You can buy an epoxy formulation for nearly any job, and there are many multipurpose formulations. Either way, epoxy is always a 2-part product consisting of a resin and a catalyst (the component that hastens the curing process). Homeowner-grade products are sold as a putty or a thick liquid dispensed from a syringe. In the case of the syringe type, you push down on the plunger to simultaneously dispense the resin and catalyst in the correct proportions. Next, you mix the two with a clean, disposable object, like a paint stirrer or a plastic knife, and apply it.

One type of syringe-delivered product is Devcon 5-minute Fast Drying Epoxy, an all-purpose adhesive. As the name suggests, this product sets in 5 minutes, which gives you some time to handle the piece. The epoxy is fully cured in about 1 hour. It comes as a 1-ounce syringe that costs about $3.50 at hardware stores and home centers.

Epoxy putty comes in the form of a roll within a roll. Slice off a piece, knead it to mix the resin and catalyst, and apply it. We show Devcon LeakStopper, a waterproof type with a 10-minute setting time. It cures to full strength in 24 hours. A 1-ounce stick costs $3.50 at hardware stores and home centers.

Contact Devcon Consumer Products, 264 Howard St., Des Plaines, IL 60018; 800-227-7950.

Super Glue

Commonly called super glue, liquid and gel cyanoacrylate adhesive forms a durable bond in seconds by reacting with trace elements of moisture in the air or on the surface of the workpiece. It's handy for small household repairs on a variety of materials, and its thin consistency and its transparency make it a good choice for repairing chipped or cracked porcelain. You apply the adhesive to the broken surface, squeeze the parts together, and that's all that's required. There are two commonly available types. One works best when bonding similar materials—while it can bond almost anything, it works best if both sides of the glue joint are the same material. The other is described as surface-insensitive and will bond two different types of material. It's a few cents more expensive than the other type. We show Loctite Quick Tite, a surface-insensitive liquid super glue that costs about $2.50 for 1.8 ounces. It's sold at hardware stores, home centers and drugstores. Contact Loctite Corp., 1001 Trout Brook Crossing, Rocky Hill, CT 06067; 800-562-8483. PM

Backup Generator Update

In our March '98 issue, page 79, we ran a story about installing a backup generator that featured a new UL-listed Square D manual transfer switch. The generator was connected to this switch with an extension cord plugged into a waterproof exterior receptacle. Several thoughtful electricians contacted us to point out a

CORRECTION

possible problem with our installation. If readers follow our use instructions, no danger is involved, but as our electrician readers pointed out, using a backup generator is usually done under less-than-ideal conditions, when people may not clearly remember our instructions. They have a good point.

By showing an exterior receptacle and an extension cord with two male ends, it is possible—though not likely—that someone could receive an electrical shock if they pulled the cord from the receptacle before turning off the generator. Our story clearly states that this should not be done. But in an emergency situation few of us think as clearly as we would like.

The better idea is to use a flanged power inlet like the Hubbell model (NEMA L14-20P) shown at right. These cost about $25 and are available at electrical supply outlets. The inlet should be installed in a waterproof box and hooked to the generator with an extension cord that has one male and one female end. We regret any inconvenience this may have caused.

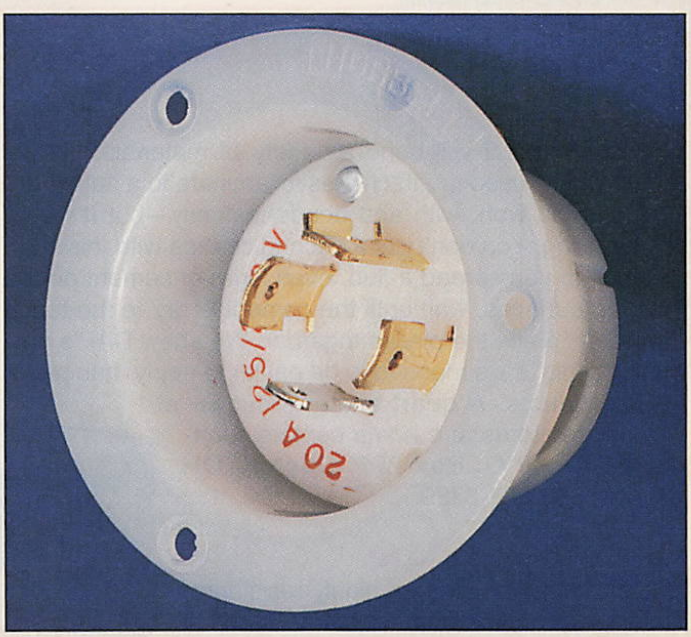


PHOTO BY MERLE HENKENIUS

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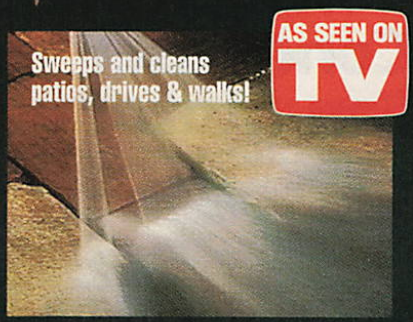

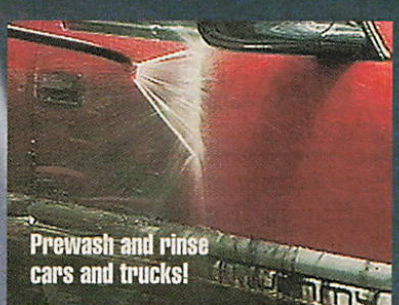

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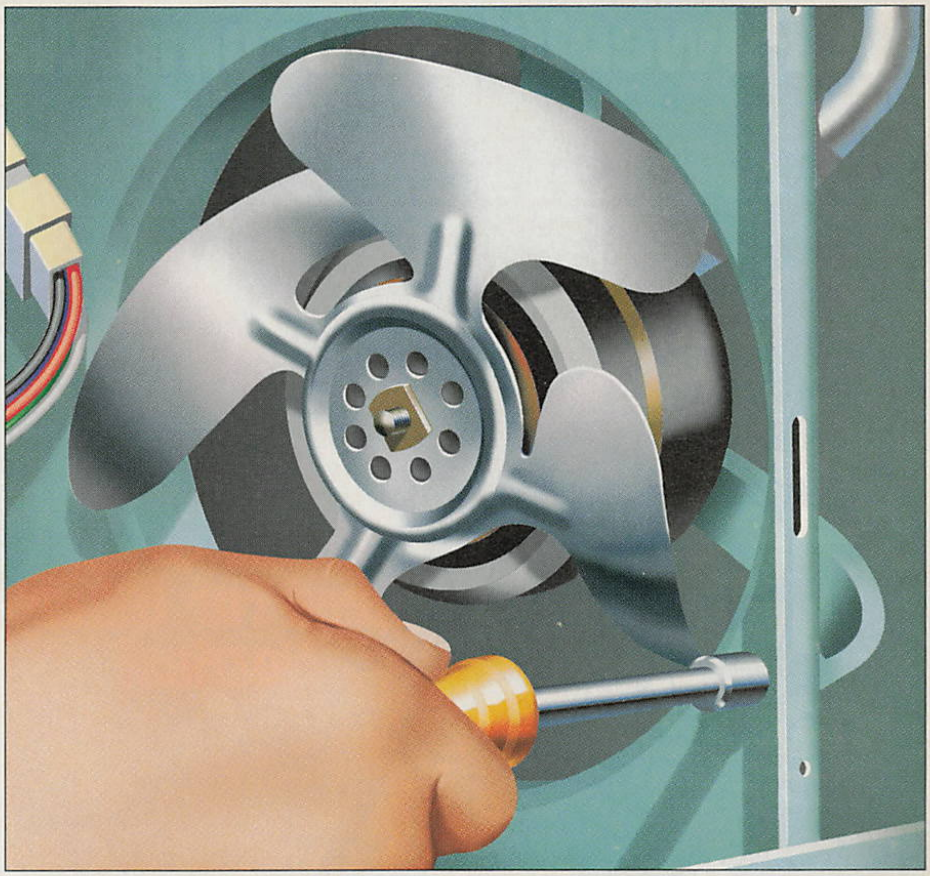
Replacing A Refrigerator Condenser Fan Motor

BY STEVE TOTH
Illustrations by
George Retseck



A condenser fan is used on frost-free refrigerators that have a condenser coil in the bottom of the cabinet, inside the compressor compartment. The fan runs whenever the compressor runs, and it draws cool room air through the front grille, and circulates it through the condenser coils, over the compressor, and back out the front grille into the room. The circulating air helps cool the compressor and the refrigerant in the condenser coils. The air also helps evaporate the water in the drain pan.

APPLIANCE CARE

If the fan stops, the temperature of the refrigerant will rise and the compressor may overheat. Eventually, the food may spoil.

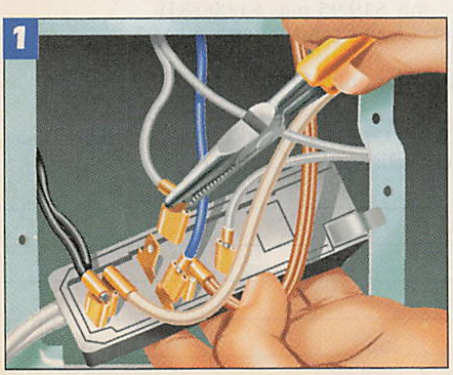
To check the condenser fan motor, first unplug the refrigerator and pull it away from the wall. Remove the rear access cover from the motor compartment. Use a paintbrush to remove the dust from the fan blades, motor and condenser. Then vacuum the area thoroughly.

Turn the fan blade to see if it moves freely. If the motor binds or doesn't move at all, replace it.

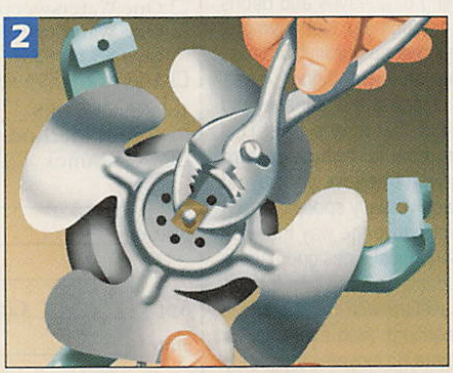
To replace the motor, follow its two wires back to the terminal block and remove them using a pair of needle-nose pliers (Fig. 1). Next, use either a nut driver or screwdriver to remove the mounting screws that hold the fan assembly and bracket onto the metal divider in the motor compartment (above). Carefully remove the assembly from the motor compartment. Next, remove the fan blade from the motor by backing off the thin rectangular nut that secures the fan to the motor (Fig. 2).

Next, take the fan blade and rubber washer off the motor shaft. Remove the mounting bracket from the old fan motor and install it on the new motor (Fig. 3). Then install the rubber washer and the fan blade on the new motor. Tighten the nut, reinstall the fan assembly and attach the motor wires to the terminal block. Check that there are no wires in the way of the blade or motor and that the fan spins freely. Install the rear access cover, then plug the refrigerator back in and test run it.

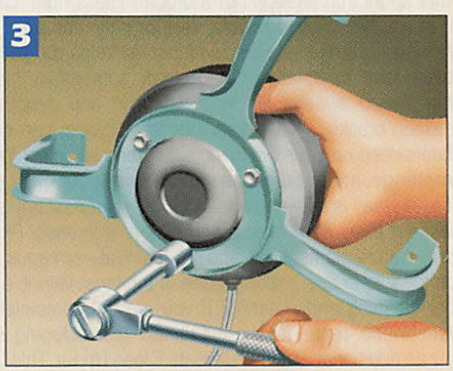
A new condenser fan motor can be obtained from the refrigerator manufacturer or a local appliance parts distributor. When ordering the new motor, supply the company with the make and model number of your refrigerator. Condenser fan motors cost between $40 and $60. PM



Trace the motor wires back to the terminal block, and carefully remove them using a pair of needle-nose pliers.



With the fan and bracket unbolted, remove the thin rectangular nut that holds the fan to the motor.



Use a nut driver or socket wrench to remove the machine screws that attach the fan motor to its bracket.

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Homeowners Clinic

BY NORMAN BECKER, P.E.
Illustrations by George Retseck

Radon Ventilation

I am concerned about radon entering my house through the basement. What can a homeowner do to reduce levels? And what levels are considered high?

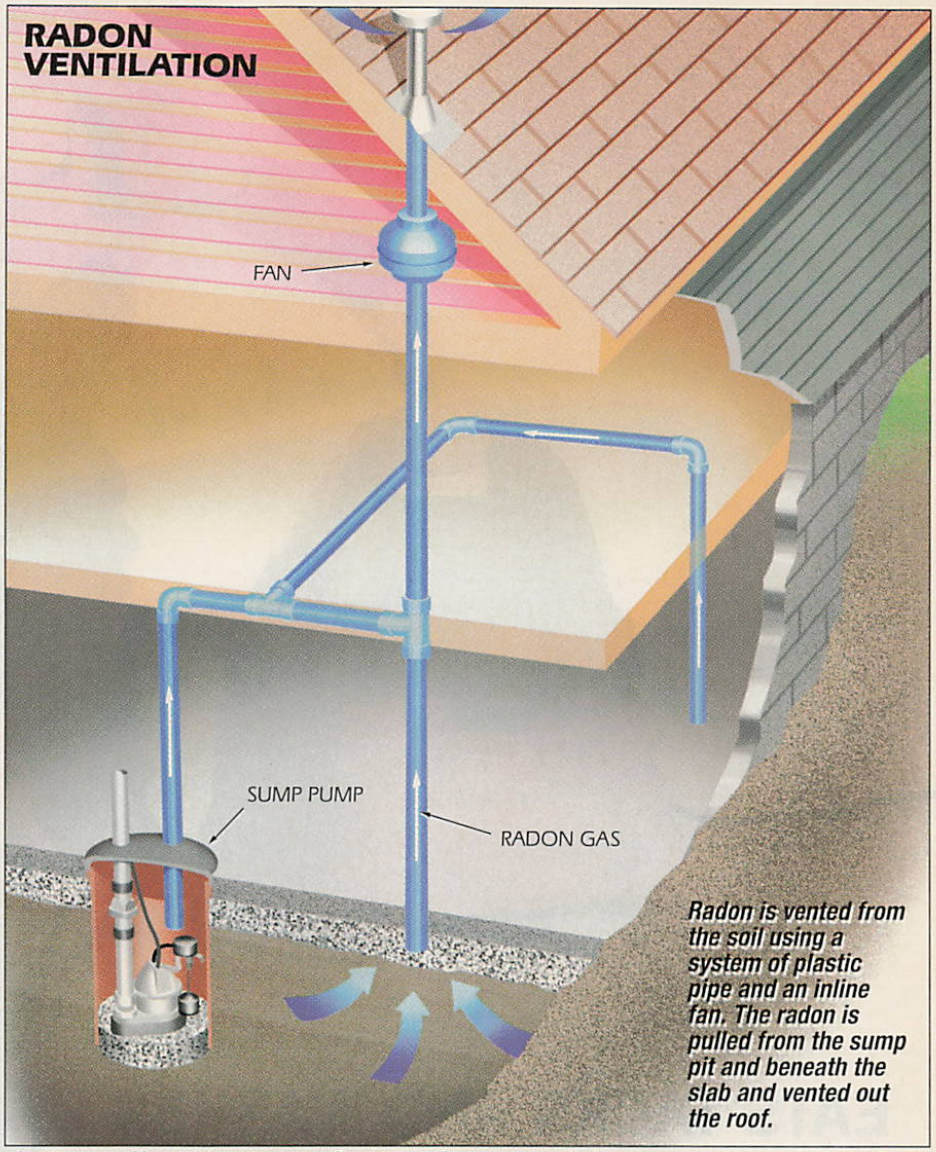
JAY BURNS
OSWEGO, IL

Radon is a colorless and odorless radioactive gas given off by decaying uranium deposits within the earth. The gas is measured in picocuries per liter of air. Federal environmental officials recommend taking measures to reduce the concentration of radon when it reaches 4 picocuries per liter (4 pCi/L).

To do this, have a contractor who is state-certified or listed with the federal Environmental Protection Agency's radon-measurement proficiency program determine the year-round average radon level in your house. This is done using a long-term test of 90 days or more, which will produce more reliable results than a short-term test of two days to 90 days.

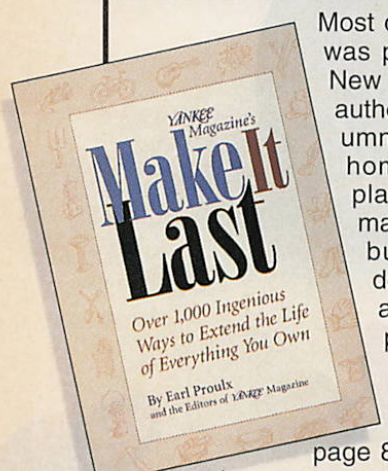
If a long-term test yields radon concentrations greater than 4 pCi/L, then the agency recommends corrective action. One very effective method is to seal cracks in the foundation wall and basement floor, and remove the radon with a ventilation system such as the one shown. This system costs from $800 to $2500. Holes are bored in the house's basement slab, pipes are inserted in the holes and sealed to the slab. An inline fan pulls the gas from below the slab and exhausts it out a roof vent.

(Please turn to page 123)

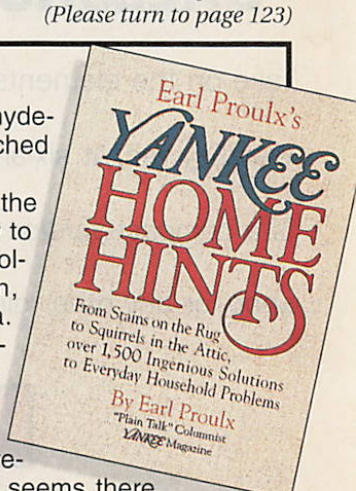


Radon is vented from the soil using a system of plastic pipe and an inline fan. The radon is pulled from the sump pit and beneath the slab and vented out the roof.

Review: Help With Just About Anything


YANKEE Magazine's
Make It Last
Over 1,000 Ingenious Ways to Extend the Life of Everything You Own
By Earl Proulx and the Editors of YANKEE Magazine

Most of the material in these two books was provided by Earl Proulx, a clever New England carpenter in his 80s and author of *Yankee* magazine's fix-it column, "Plain Talk." He even built his home from a POPULAR MECHANICS plan. *Make It Last* explains how to maintain and reuse household items, but it's also a tribute to Proulx's doughty, Depression-raised generation. As a group, these thrifty people seem to often see opportunity in the discarded and broken. Speaking of which, 12 uses for dead pantyhose are listed on page 87. On page 323, an old glove finger becomes a protective chisel sheath. And Proulx recalls his adventures and misadventures, like the time he built the office for a rural gravel plant and unknowingly quenched his thirst with formaldehyde-contaminated water that had leached from a nearby cemetery.


Earl Proulx's
YANKEE HOME HINTS
From Stains on the Rug to Squirrels in the Attic, over 1,500 Ingenious Solutions to Everyday Household Problems
By Earl Proulx
"Plain Talk" Columnist
YANKEE Magazine

Yankee Home Hints is in much the same vein, in that it instructs how to clean, restore, build, polish, demolish, move, float, burn, maintain, ventilate—well, you get the idea. Try these topics on for size: removing stains from a carpet, fortifying a screen door to protect the screen, maintaining a stuffed deer head, building a coal fire and responsible paint disposal. In all, it seems there isn't any job the author hasn't tackled in his long career.

A hardcover book, *Make It Last* costs about $28. *Yankee Home Hints*, a softcover, costs about $15. Both are sold at bookstores. Contact Rodale Press, 33 E. Minor St., Emmaus, PA 18098; 800-848-4735. —*Roy Berendsohn*

PHOTOS BY ROSARIO CAPOTOSTO

Deck Treatment

I am planning on power washing my pressure-treated wood deck to remove accumulated dirt and mildew. Is it necessary to coat the deck after power washing it?

MIKKI BIEBER
MONSEY, NY

Yes, the deck should be coated. Unprotected wood exposed to the weather goes through a swell-shrink cycle with each rain. This causes internal stress at the interface between the wet and dry wood cells, which eventually results in cracking, checking and splintering. In addition, the lignin that holds the wood cells together degrades when it is exposed to the ultraviolet rays in sunlight. All of these processes are minimized when you coat the deck with lightly pigmented water repellent.

In order to control the growth of surface mildew, which results in gray and black stains, a mildewcide is added to the water repellent, and the mixture is then referred to as a water-repellent preservative.

Algae Growth On Shingles

I would like to know what causes black streaks on asphalt shingles. How do I remove these streaks?

KEITH MCGILL
STARR, SC

The black streaks are probably caused by microscopic algae spores that are carried on the wind and settle on the roof. The algae spores grow on the roof and become visible. Although algae grows best in a warm, humid environment such as is found in the South, it can be found throughout most of the states.

You can clean the roof using a mild solution of 1½ ounces chlorine bleach per 1 gal. of water. Apply the bleach-water solution with a sponge or garden sprayer and then rinse it off with fresh water. Unfortunately, though, the algae discoloration will probably return.

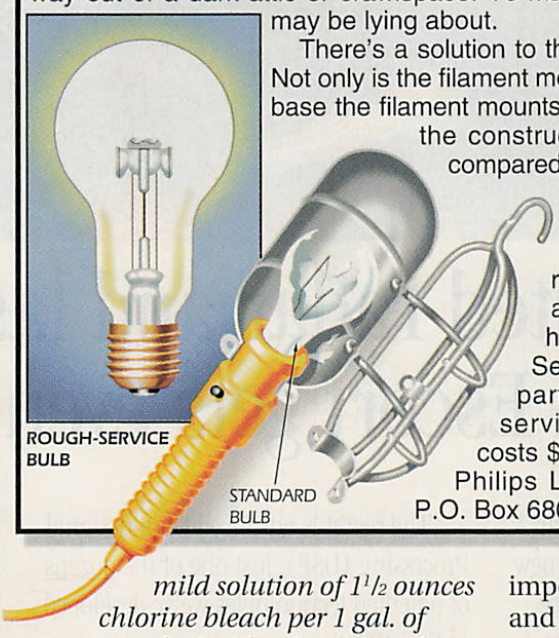
To prevent this, you would need to install copper or zinc strips across the length of the roof. Place them immediately below the ridge and then every few feet down the roof's slope. Rainwater running over the strips forms a compound that washes over the shingles and retards algae growth. One product is Shingle Shield. It's sold at home centers and lumberyards. Contact Chicago Metallic, 4849 S. Austin Ave., Chicago, IL 60638.

A Bulb That's Not A Tough Break

SERVICE TIP: MAINTENANCE

It's a nasty surprise to hit or drop a worklight and be left to grope your way out of a dark attic or crawlspace. To make matters worse, glass shards may be lying about.

There's a solution to this problem: rough-service bulbs. Not only is the filament more rugged in these bulbs, but the base the filament mounts in is also quite substantial. Note the construction of the rough-service bulb compared to the standard bulb in the worklight. Also, you can get silicone-coated rough-service bulbs that are highly shatter resistant. Although these bulbs are available at industrial supply houses, you can also find them at Sears and home centers. At auto parts stores they are called auto service bulbs. Typically, a 2-pack costs $2.50 to $3. One manufacturer is Philips Lighting, 200 Franklin Sq. Dr., P.O. Box 6800, Somerset, NJ 08875. —*R.B.*



Crawlspace Ventilation

As an architectural designer/draftsman, I've had problems convincing homeowners and contractors of the importance of proper ventilation and vapor barriers. However, I was concerned about the misprint of 1-sq. ft. of unobstructed vent area for each 1500 sq. ft. of crawlspace floor as mentioned in the July 1997 "Clinic." Current Uniform Building Code (UBC) and state specifications require 1 sq. ft. per 150 sq. ft. of crawlspace floor area.

DWAYNE BAIER
STEILACOOM, WA

There are two conditions that govern the amount of ventilation required for a crawlspace. If the floor in the crawlspace is exposed to earth, then the net-free vent opening must not be less than 1 sq. ft. for each 150 sq. ft. of crawlspace floor area. However, when the floor is covered with an impervious membrane, such as an approved vapor barrier, like 4- or 6-mil polyethylene sheets, then the net-free vent opening may be reduced to 10% of that figure, or 1 sq. ft. of vent opening per 1500 sq. ft. of crawlspace floor area. My recommendation in the column that you cite included the use of a vapor barrier. PM

BUZZWORD • • • Depressurization

Air can leave a house any number of ways. It can be pulled into the attic by an attic fan where it is then exhausted outdoors. And bath and kitchen fans may exhaust air outside, although they don't always. Another device that moves indoor air to the outdoors is your clothes dryer. A fire in a fireplace contributes to a huge loss of indoor air and, finally, boilers and furnaces that use indoor air for combustion also contribute to the loss. All this may result in depressurization. This is often the case when a house is tightly constructed and the air leaving is not replaced. The air pressure inside the house may be less than outdoor air pressure. In the case of a tight house, combustion gases exhausted to the outside could be pulled back inside. —*R.B.*

DO YOU HAVE A HOME-MAINTENANCE OR REPAIR PROBLEM?

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Automotive Car Care

Auto Clinic

BY MIKE ALLEN

Overstepping The Bounds

I just replaced the calipers on my pickup with rebuilt ones. The guy at the parts store told me I needed a master cylinder, too. Being the skeptical sort, I told him the master cylinder was fine, and I'll just take these calipers, please. And he says, "You'll be back in a few days for a master cylinder."

Darn if he wasn't right! Two days later there was brake fluid all over the rubber mat and my boot as a result of a leaky master cylinder. How did he know?

JOHN CALVAS
TUCUMCARI, TX

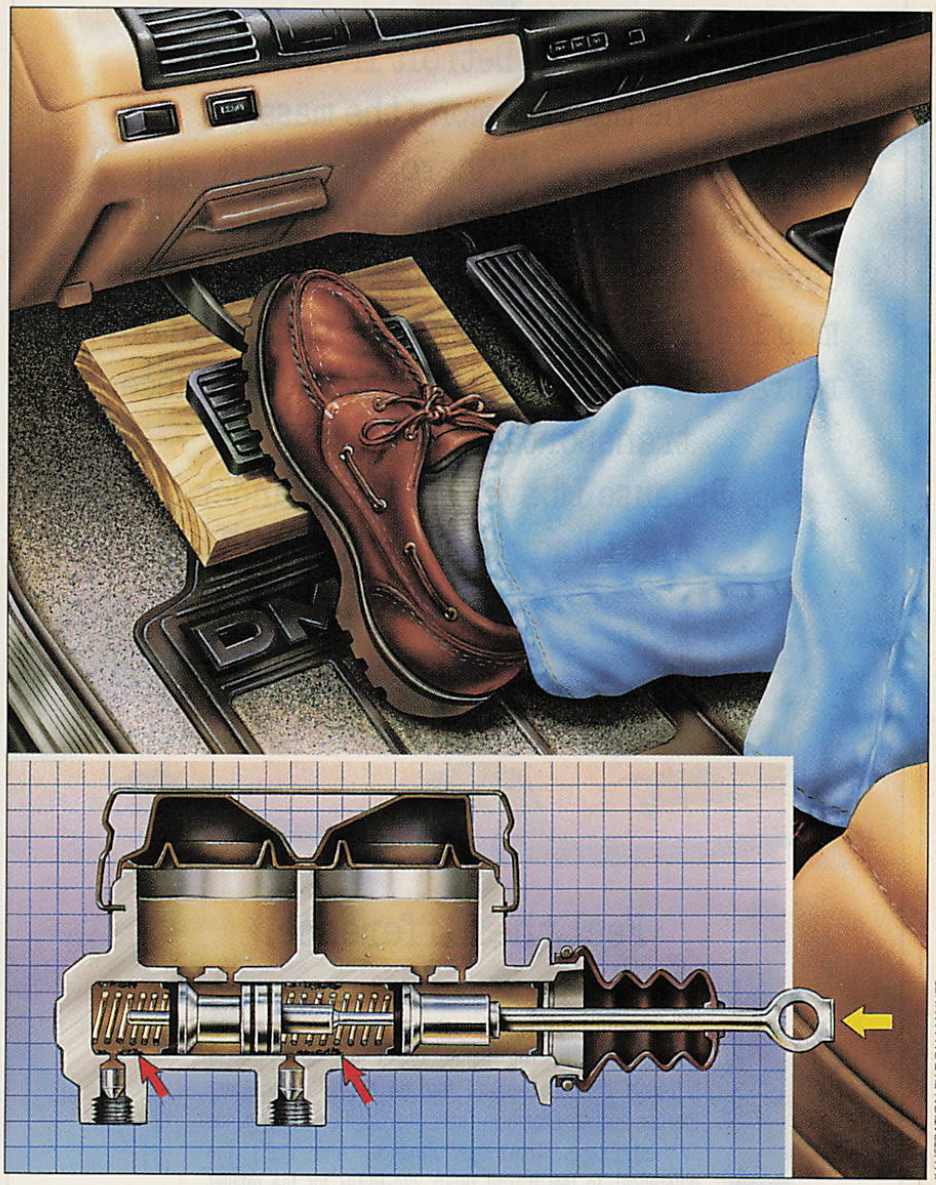

ILLUSTRATION BY DON MANNES

Here's what happened, and it's only tangentially related to your replacing the calipers: After you replaced the calipers, you had to bleed the brakes. The counterman knew that you were not a professional mechanic and that you were probably going to bleed the new calipers manually, rather than use a pressure bleeder.

Normally, when you depress the brake pedal, the pedal stops several inches above the floorboard. The piston and its fragile rubber lip seals never travel into the very bottom of the master cylinder because the hydraulic pressure keeps the pedal up those few inches. Deposits and corrosion can build up in the bore of the master cylinder on the area that's never disturbed. When you bleed the brakes manually, the piston will sweep this part of the bore because you stroke the brake pedal all the way to the floor. The corrosion can cut the rubber seals, and you've got a leaky master cylinder.

A pressure bleeder doesn't rely on stroking the piston all the way up and down. It uses compressed air to force fresh brake fluid into the reservoir and flush the air out of the calipers' bleed screw.

If you've had a leaky caliper or hose and the brake pedal has touched the floor, and you have an older vehicle that hasn't had regular brake fluid changes, the damage has already been done. But if the caliper was just sticky and you've decided to change it before it started to leak, you can prevent seal damage very simply. Toss a chunk of wood under the pedal before you start bleeding. This will prevent the pedal from being depressed too far, the piston from entering too far into the master cylinder, and the seals from leaking. It will take an extra stroke or two to bleed the air from the system, but it may save a lot of grief later.

Cool Runnings

I've been losing coolant from my Dakota pickup for a while, and it's gotten so bad that I can see it leaking out of the upper seam, where the plastic top is crimped onto the aluminum radiator. The radiator shop says it can't be fixed. A new radiator is $290. I was wondering if a copper radiator from another company could be substituted. I was

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also wondering if replacing the 16-psi radiator cap with a lower-pressure 4- or 8-psi cap would help.

CLAUDE VAIL
IOLA, KS

I'd start with another radiator shop and see if that aluminum radiator can't be fixed. It's often possible to remove the crimp strip that holds the plastic top tank to the radiator body, replace the O-ring that seals the lip, and recrimp the two together. For some applications, it's possible to replace just the upper or lower tank if you can find the parts.

Sometimes. If not, you'll have to buy a new radiator. There may or may not be an aftermarket copper replacement radiator, but it'll be just as expensive, and heavier.

Don't replace the cap with a lower-pressure-rated one. As a last resort, you might try a salvage yard for a good used radiator.

My Little Runaround

About six months ago I purchased a 1994 Hyundai Excel with 44,000 miles on it. Two days later, I checked the oil and it read completely empty, so I added oil to the fill level and drove to the dealer. They told me 1 quart in 1,000 miles was normal and replaced the valve stem seals. It continued to consume oil. Next, they did an oil consumption test. It showed oil consumption as 1 quart in 1622 miles, 1 quart in 692 miles, 1.5 in 374 miles, and 1 quart in 224 miles. They say the rings are fine, and the compression is fine. They tried to tell me nothing is wrong. Now my car is smoking out of the exhaust, and if you put your finger in the tailpipe it comes out covered with oily black soot—which they claim is normal carbon buildup.

The point is that my car is still under warranty, and I feel that I'm being given the runaround so they don't have to fix it. I feel like I'm being scammed.

CRYSTAL CABALLER
NO ADDRESS GIVEN

I think you're being given the runaround. Your engine shows a clear downhill trend, and I doubt the oil consumption will level off at 220

(Please turn to page 129)

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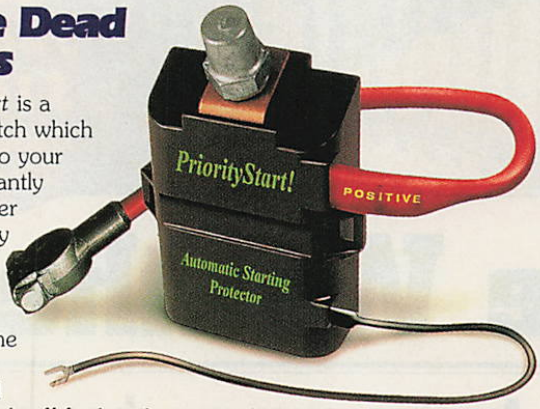

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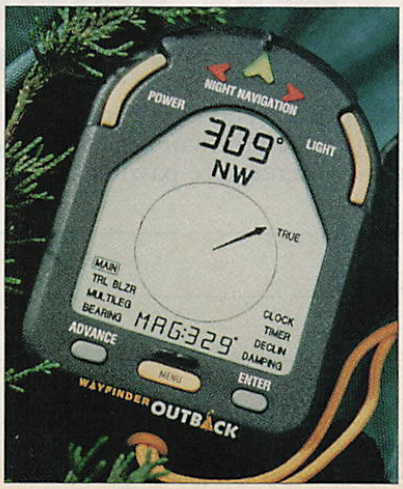

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Oh My Stars And Garters

CAR CARE TIP

I was replacing a set of brake pads the other day because the owner complained that the old pads didn't seem to work very well. It was easy to see why—one side of the brake disc was covered in burned, blackened wheel-bearing grease. The owner said he had just repacked the wheel bearings a few weeks ago. I assumed he had overpacked the cavity in the hub with grease and it had leaked out. But I pulled the disc anyway, only to discover the bearings highly spalled and the grease full of metal. Somehow he had dislodged the small coil spring, called the garter spring, from the lip of the seal. Not only did the seal not seal, but the spring got chewed up in the bearings. New bearings, a new seal and a lot of cleanup later, I packed the cavity half-full of grease, reinstalled the disc and wheel, and he was on his way.

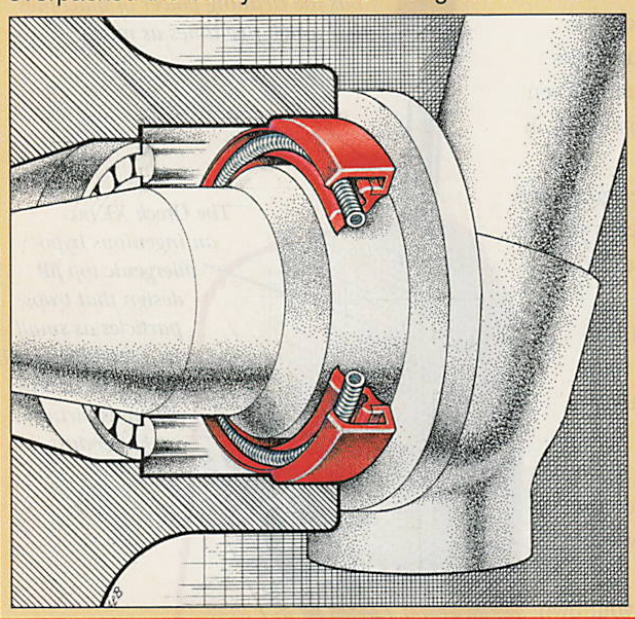

ILLUSTRATION BY ADOLPH E. BROTMAN

miles per quart. Besides, that much oil will damage the converter and make it tough to pass the emissions sniffer. Your engine needs to come apart.

Tanks For The Memory

When I changed the air cleaner element on my daughter's 1990 Nissan 240SX, it seemed soggy, or wet. I was looking at the air inlet duct and there's a small plastic tanklike thing branching off to one side. This tank was wet on the inside. What could cause this?

DAN GILLIGAN
VIA INTERNET

I suggest you tell your daughter to drive more slowly through those big puddles. That small tank is called a Helmholtz resonator. It's there to reduce intake air resonance at some engine speeds. It works by bouncing a pulse of air back into the intake path exactly 180° out of phase with a noise pulse reflected by the closing intake valve. It's cheap and it works. It was wet because water somehow found its way inside the air intake. Just be sure everything is clean and dry when you reassemble it. PM

DO YOU HAVE A CAR PROBLEM?
Just ask Mike about it. Mail your question to Car Clinic, Popular Mechanics, 224 W. 57th St., New York, NY 10019. While letters, faxes or phone calls cannot be answered individually, problems of general interest will be discussed in the column.

SERVICE TIPS

- Four new engine-cradle mount isolators may be needed to get rid of a metallic popping, or "oil-canning," noise at the front of a 1996-97 Chrysler Concorde, Intrepid, Vision, LHS or New Yorker. Technical service bulletin (TSB) 13-01-97.
- Brakes grabbing on your 1983-97 Ford Ranger or 1991-94 Explorer? High humidity causes it, and Ford has come up with new rear brake shoes to eliminate it. TSB 97-14-16.
- Audi switched to a new, red engine coolant (PN G 012 A8D A1) in August 1996. Mixing any other coolant with this one will cause engine damage. TSB 96-01.
- Hyundai has revised some critical engine torque specs for 1996-97 Elantras and 1997 Tiburons. Beg, borrow or steal an up-to-date service manual before touching the engine. TSB 96-20-003-1.

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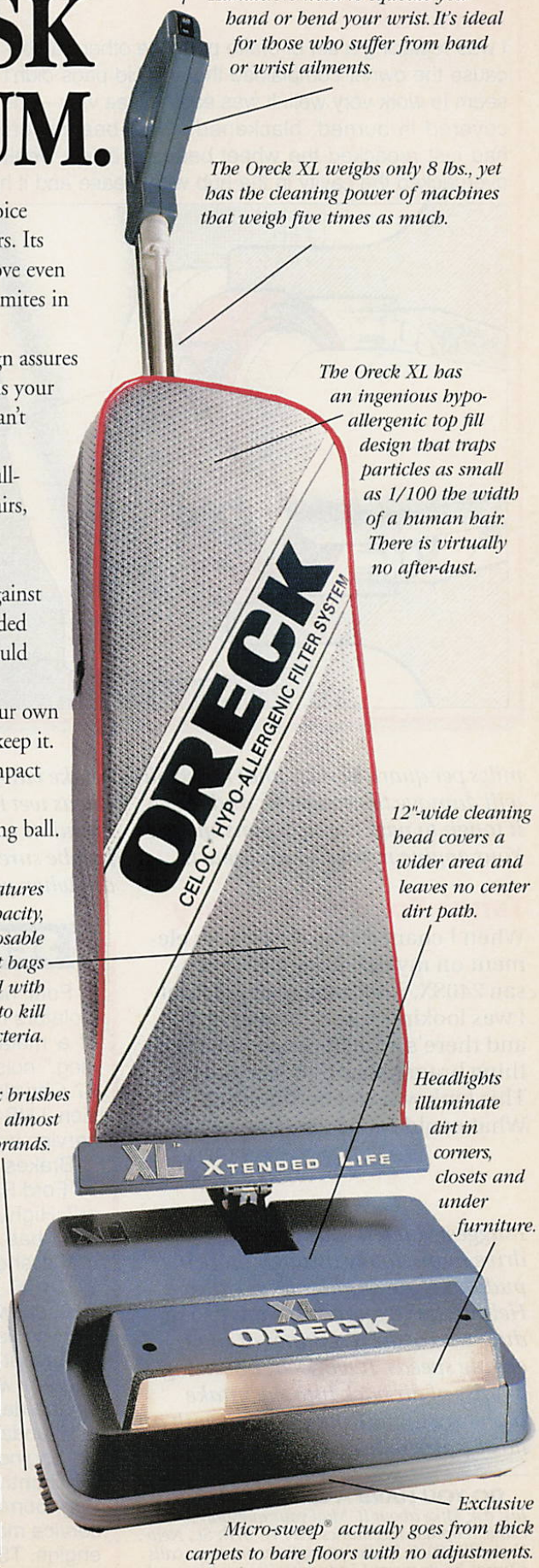

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Automotive Car Care

Replacing Your Air Filter

BY PAUL WEISSLER

Your mileage

has been dropping steadily for months. A tuneup is in order, so a fine Saturday morning finds you on a deserted stretch of road. You figure a few miles of spirited driving should blow out the cobwebs and restore that ponycar performance. But what happens instead is black smoke, a lot of noise and not much performance at all. Time to check the air cleaner—which is plugged with dirt, bugs and leaves.

SATURDAY MECHANIC

Every engine has an air filter, and although there have been many types of air-filtering materials tried over the years—including oil-wetted plastic foams and wire mesh—dry, pleated "paper" (actually resin-impregnated, heat-cured fiber) continues to be the material of choice for filter elements in everything from cars to heavy-duty trucks and off-road equipment.

Housing Project

Check your air filter at least once a year. All air-filter housings are somewhere under the hood. The housing cover may be held by wingnuts or spring clips—pretty straightforward stuff. Separate the cover from the housing and you can lift the filter out for inspection. Many filters, particularly the narrow cylinders used on older rear-drive cars and even on many of today's trucks, can be rotated. If there's a dirty area near the air intake, tap the filter against a table to remove loose dirt, then turn it 180°

Degree of Difficulty

EASY

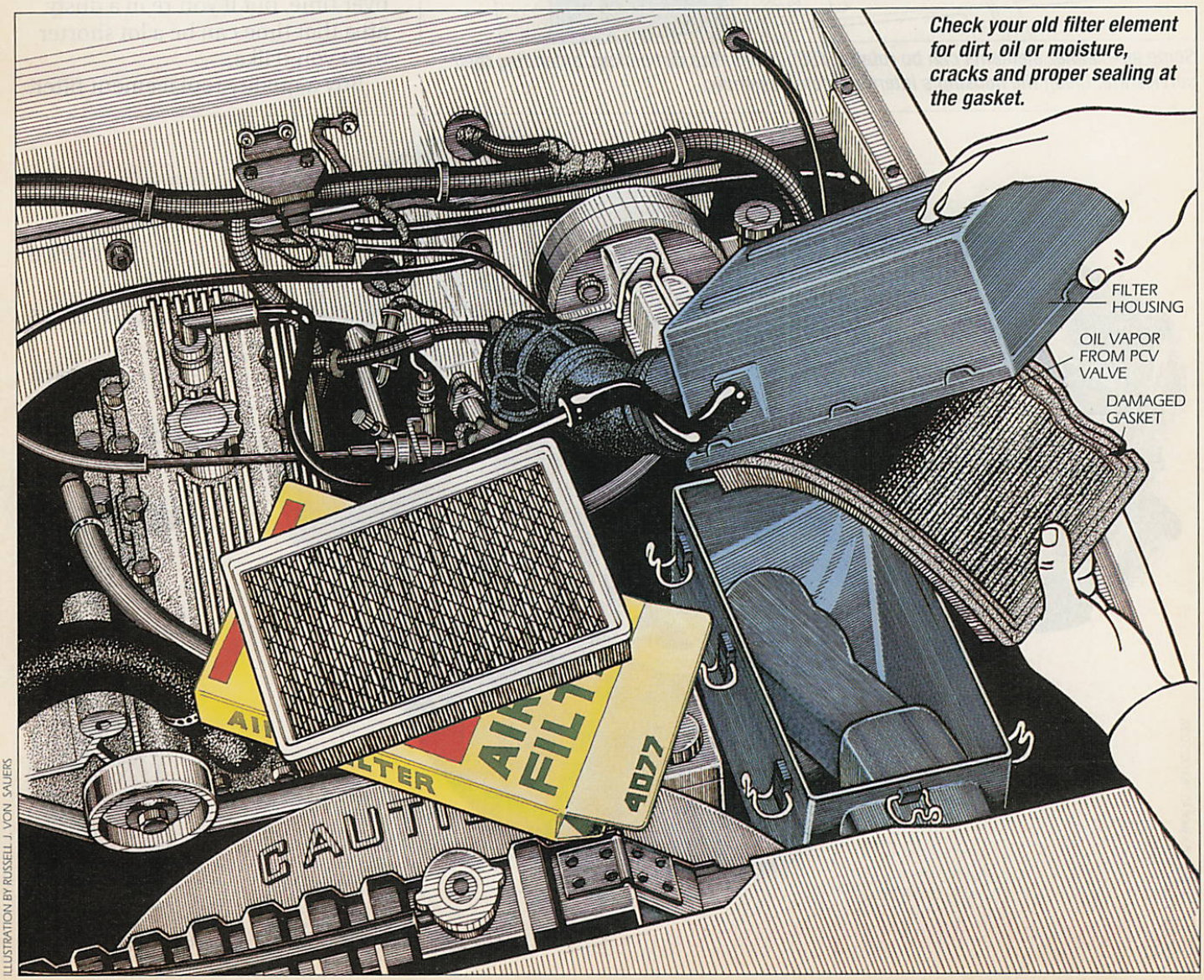
Check your old filter element for dirt, oil or moisture, cracks and proper sealing at the gasket.
FILTER HOUSING
OIL VAPOR FROM PCV VALVE
DAMAGED GASKET
AIR FILTER
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ILLUSTRATION BY RUSSELL J. VON SAUERS

Replacing Your Air Filter

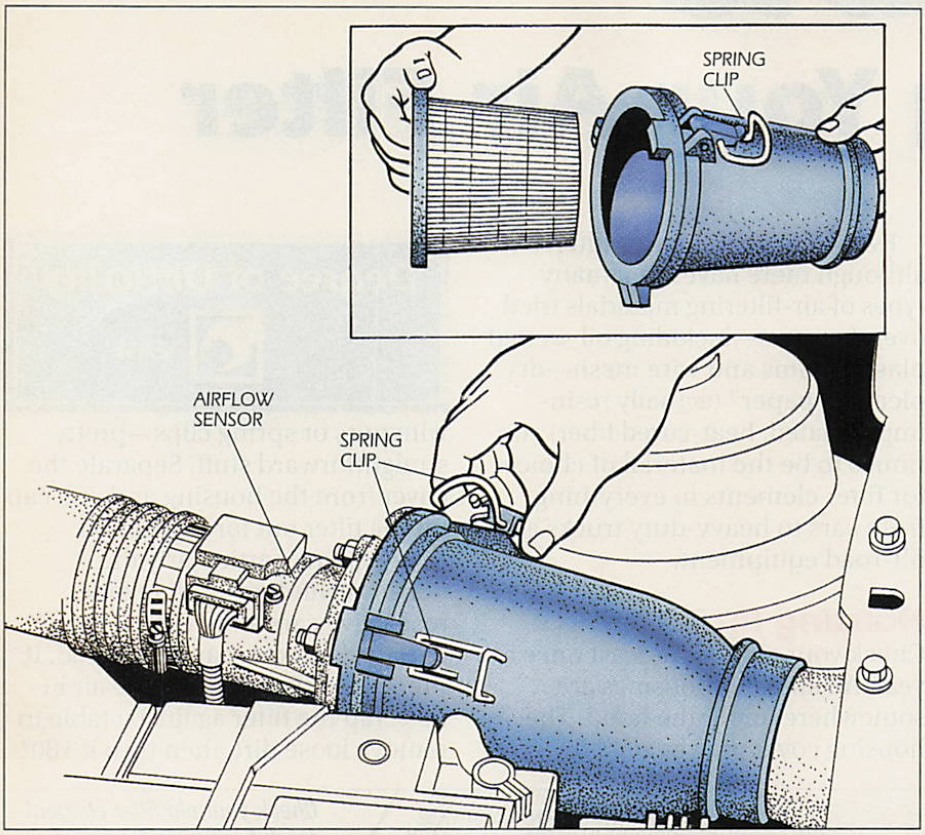

ILLUSTRATION BY RUSSELL J. VON SAUERS

Some air-cleaner elements can be rotated 180° to equalize dirt pickup, extending their service life. Clean the housing's interior before assembly.

and expose a fresh surface to the air intake. Some conical filters also can be rotated, but others can't. Never try to clean a "paper" automotive filter in detergent and water. Some heavy-duty filters are designed to be cleaned several times, but automotive filters are not.

Before you reuse a filter, however, inspect it for cracked pleats. The best way is to hold the dirty side of the filter in front of your eyes with good lighting on the opposite side (with a cylindrical filter, hold a trouble light in the middle of the opening). Of course, you should see some translucence (if you don't, the filter is plugged). But if you see even a single line of light, which indicates a hairline crack, discard the filter. A lot of unfiltered air can get through a crack, and it's the abrasive dust in the air that wears engines. Sure, that wear takes place over time, but if you're in a dusty area that time can be a lot shorter than you'd like.

Buy a quality replacement filter.

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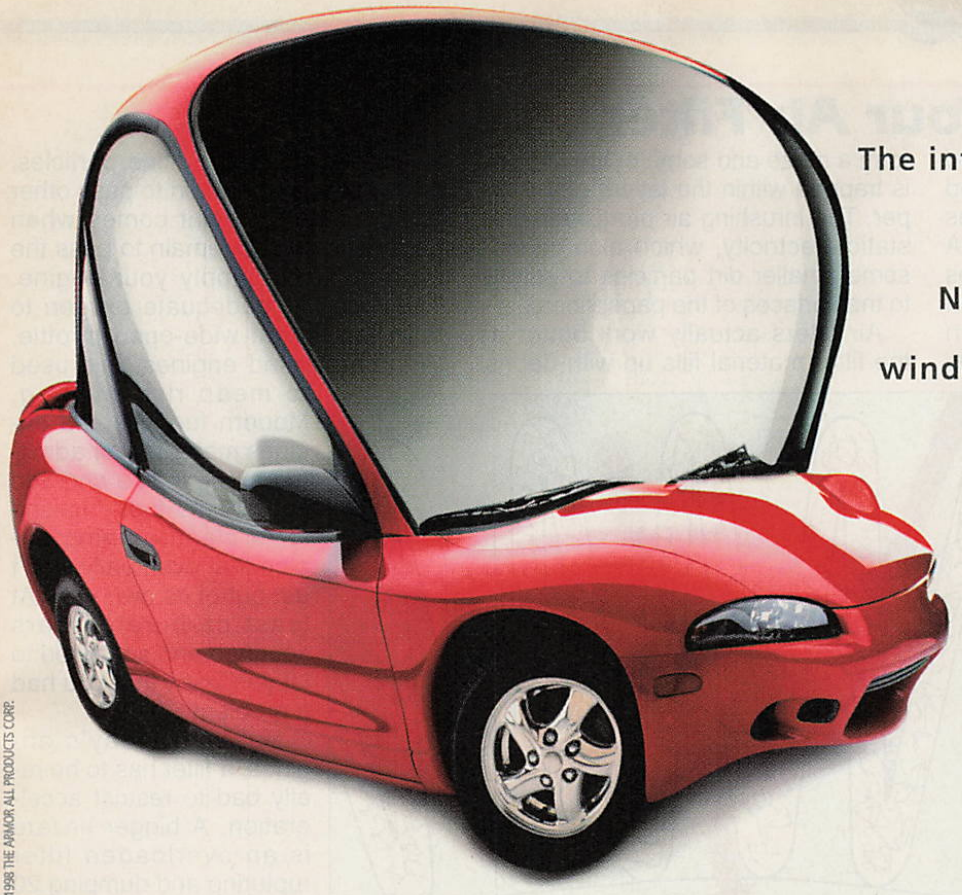


The top brands are different from the no-name cheapies you may see. There are many grades of filter "paper" and the more expensive ones used by the top brands have more consistent pores, so they do a better job of trapping dirt. In addition, their pleats are more precisely spaced so the filter has the maximum surface area for the size of the housing.

Metering The Air

Just downstream of the filter housing, perhaps connected by a duct, will be the engine's airflow meter, or sensor. (Some engines have no airflow meter. Instead, their computer calculates air intake using rpm, intake vacuum and barometric pressure.) Contamination of the airflow meter will give your engine's computer inaccurate information about the amount (mass) of air the engine is burning. That could mean poor driveability, poor mileage and hard starting.

Don't, however, try to clean the airflow sensor, save for blowing loose dirt and cobwebs with your breath. The calibration of these instruments is fragile, and you stand a good chance of mucking your sensor up irreparably.

Duct Hunting

Before you install the new filter, inspect the duct from the throttle body to the filter housing. Spread the flutes of the duct, looking for cracks. If the duct is cracked, it may be closed at idle but spread on acceleration, when the engine torques. That not only brings in unfiltered air, but on today's engines with mass airflow sensors, the dirty air also is "unmeasured." The amount of fuel sprayed by the injectors is determined by how much air is flowing in, so if some of that airflow isn't measured by the sensor, not enough fuel will be injected. The engine will run lean and hesitate and/or stumble. The same thing can occur if the duct isn't properly fitted and clamped at each end.

Find a crack? Well, it's a duct, so you can repair it with duct tape. That's a move that no professional would make, because in time the tape will lose its grip in the heat of the engine compartment, as the duct flexes. But it's your car, and if you are willing to recheck and retape frequently, you can save the cost of the new part, or at least postpone the expense.

Fit Is Important

Carefully check the fit between the lips of the housing and the rubber gasket rimming the filter. This gasket not only seals the filter housing's two halves together, but also provides an airtight and dirt-tight seal between the filter and the clean side of the housing. Look carefully at the old filter's gasket. It should show a smooth, clean line 360° around at the sealing face on both sides. The rim of the filter housing will have compressed the rubber gasket if everything is correct. If not, a little detective work is in order. Is the filter the correct part? If not, is your replacement filter the correct part? Don't rely on just a visual comparison—look up the correct part number and cross-reference.

Were all of the spring clamps properly latched? Some air cleaners

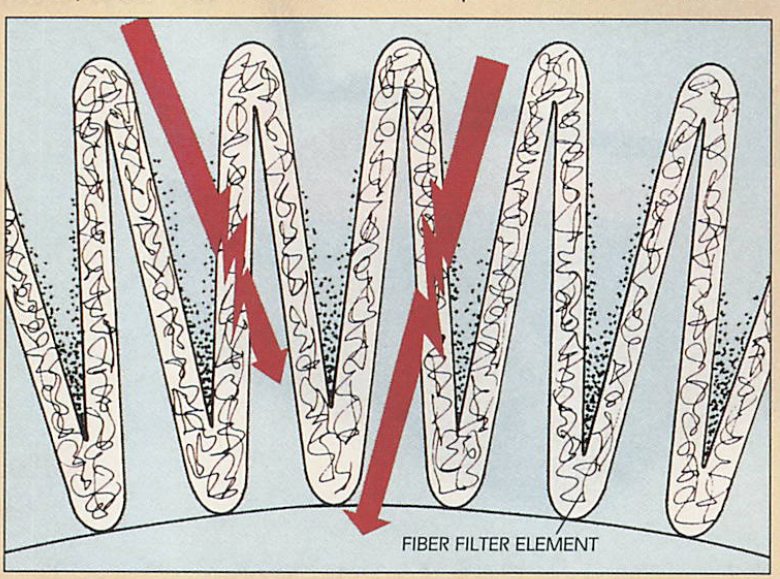
How It Works: Your Air Filter

The resin-impregnated, heat-cured "paper" element looks like a pleated sheet, and most of the dirt particles are stopped at the outside surface. A light coating of dirt actually improves the filtering ability of the paper. But soon the dirt builds up and even starts filling the bottoms of the pleats, restricting airflow. The paper also has multiple layers, and if you looked at it under a microscope, it would look like a forest with an irregular crisscross of vines and limbs—the fiber strands of the "paper."

It all looks random, but the premium-priced filter "papers" are more consistent in the sizes of the pores than it seems, and a quality material is a mathematically predictable barrier to dirt particles. In actuality, the layers of fibers form a maze and some of the dirt also is trapped within the layers of the paper. The inrushing air produces some static electricity, which also causes some smaller dirt particles to adhere to the surfaces of the paper fibers.

Air filters actually work better as the filter material fills up with debris. Holes are plugged by fine particles, and fewer voids remain to pass other particles. But a point comes when not enough voids remain to pass the air needed to supply your engine. The result is inadequate oxygen to burn the fuel at wide-open throttle. With carbureted engines, this used to mean rich running. Modern fuel-injected engines meter the air admitted to the intake and add appropriate fuel—making for a clean-running engine that eventually won't get out of its own way. At least carbureted cars coughed and sputtered to let you know that you had a problem.

But with today's engines, a filter has to be really bad to restrict acceleration. A bigger hazard is an overloaded filter rupturing and dumping 20 miles of bad road into your engine.



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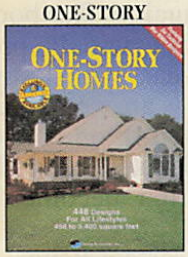

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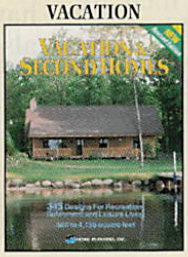

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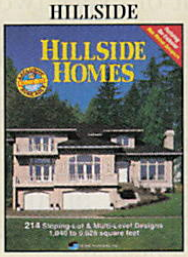

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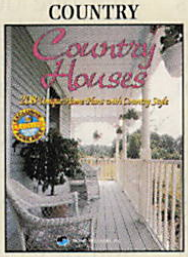

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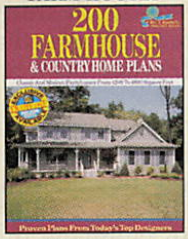

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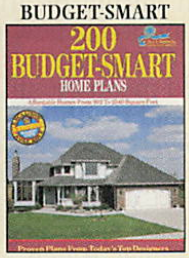

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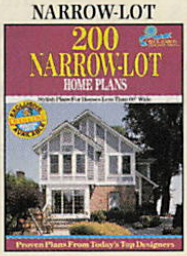

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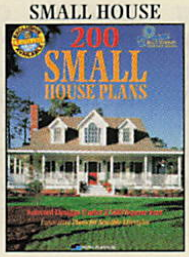

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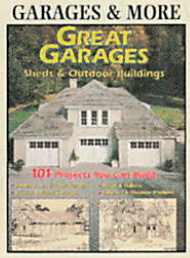

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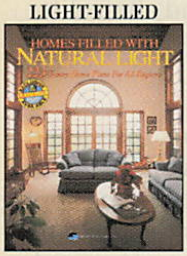

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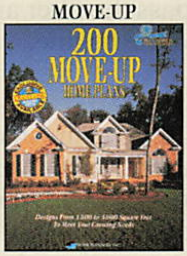

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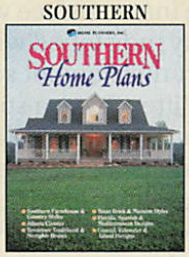

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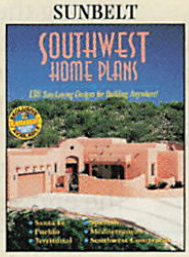

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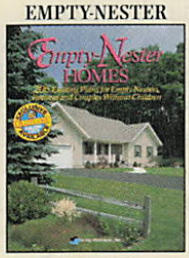

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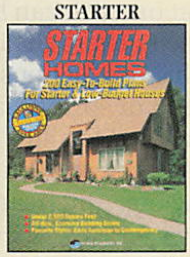

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The Doctor's Prostate Report is a remarkable, highly informative work written by the leading prostate specialist in the country, Dr. James Balch. In language that anyone can understand, Balch explains-in detail—everything from why prostate problems (and cancer) develop to how you can prevent these dreaded ailments.

The Doctor's Prostate Report shows you how to get relief from distressing and often painful prostate symptoms-without sur-gery or pharmaceutical drugs that frequently have disastrous side effects. It describes a simple nutritional combination, used safely in Europe for more than 40 years, that can actually shrink a swollen prostate and protect your sexual potency.

This book comes at just the right time since researchers project that one out of every two men are going to have prostate problems (if they don't already). Dr. Balch also explains that there are three different prostate problems: an inflammatory condition of the prostate called prostatitis; BPH, the age-related swelling of the prostate that leads to frequent urination; and prostate cancer.

If not handled, prostate disease can do everything from causing intense pain and hindering sexual intercourse to causing infertility. Death from the last stages of prostate cancer is man's most-painful experience. *The Doctor's Prostate Report* is loaded with protective, safe and all-natural strategies that will help anyone alleviate prostate problems and protect against prostate cancer.

Interestingly, the prostate causes some of the major health problems for American men. Each year 400,000 of them spend over three billion dollars on prostate surgery, and as a result, half of them never have an erection again. The book also reveals that the widely prescribed drug, Proscar, which supposedly shrinks an enlarged prostate, does not work on half of those taking it. Equally disturbing, impotence often becomes a side effect.

The Doctor's Prostate Report is an important, practical book for all men-whether they have prostate problems or not. It is available for only $14.95 (plus $3 for postage and handling). To order, send your name and address with payment to *Health Quest Publications*, P.O. Box 34007, Dept. 1800, Fullerton, CA 92834-9407. You may return the book within 90 days for a refund if not completely satisfied.

Car Care

Continued from page 134

use screws to hold them shut, while others use a large wingnut. All of the fasteners need to be tight, even that one you can hardly see or reach next to the battery. On a few vehicles, the housing is attached by a bolt or spring clamp that can be removed to allow the housing to be displaced an inch or two, permitting big, American-sized hands to fit into a narrow space.

Ready to install the filter element? Clean out the housing first, wiping the inner surface with a cloth lightly moistened with solvent. Insert the element so it seats properly. Filters have a specific side up or toward the throttle body, and you have to install it correctly so the end seals line up with the shape of the housing or its cover. If they don't, you won't get a good end seal, and incoming air may bypass the filter and allow dirt into the engine.

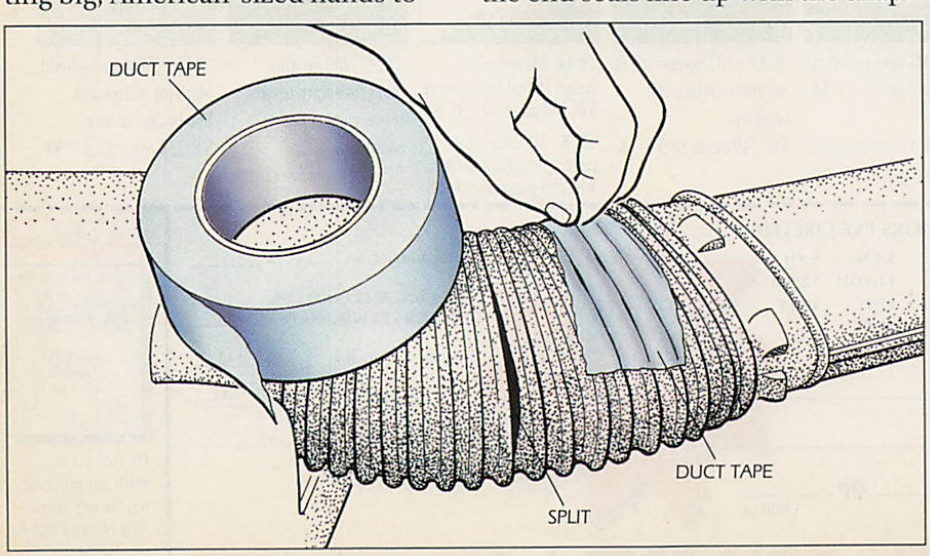

ILLUSTRATION BY RUSSELL J. VON SAUERS

Check the air cleaner's ductwork for leaks and splits, especially if you're having driveability problems. Temporary repairs can be made with ordinary duct tape.

Buttoning Up

It's time to finish up. Install the cover or the halves of the filter housing. In addition to the spring clips and wingnuts that hold the parts together, there also may be alignment tabs in areas you can't reach with your fingers. Be sure the tabs are engaged as you fit the halves together, so the two parts of the housing form an airtight joint when you turn the wingnuts or engage the spring clips.

Be absolutely sure that both ends of any ductwork are properly sealed to both the air cleaner body and the airflow meter or throttle body, including hose clamps or retaining clips. Remember, that rubber hose will become soft when underhood temps rise, so don't rely on the rubber's stiffness when it's cold. **PM**

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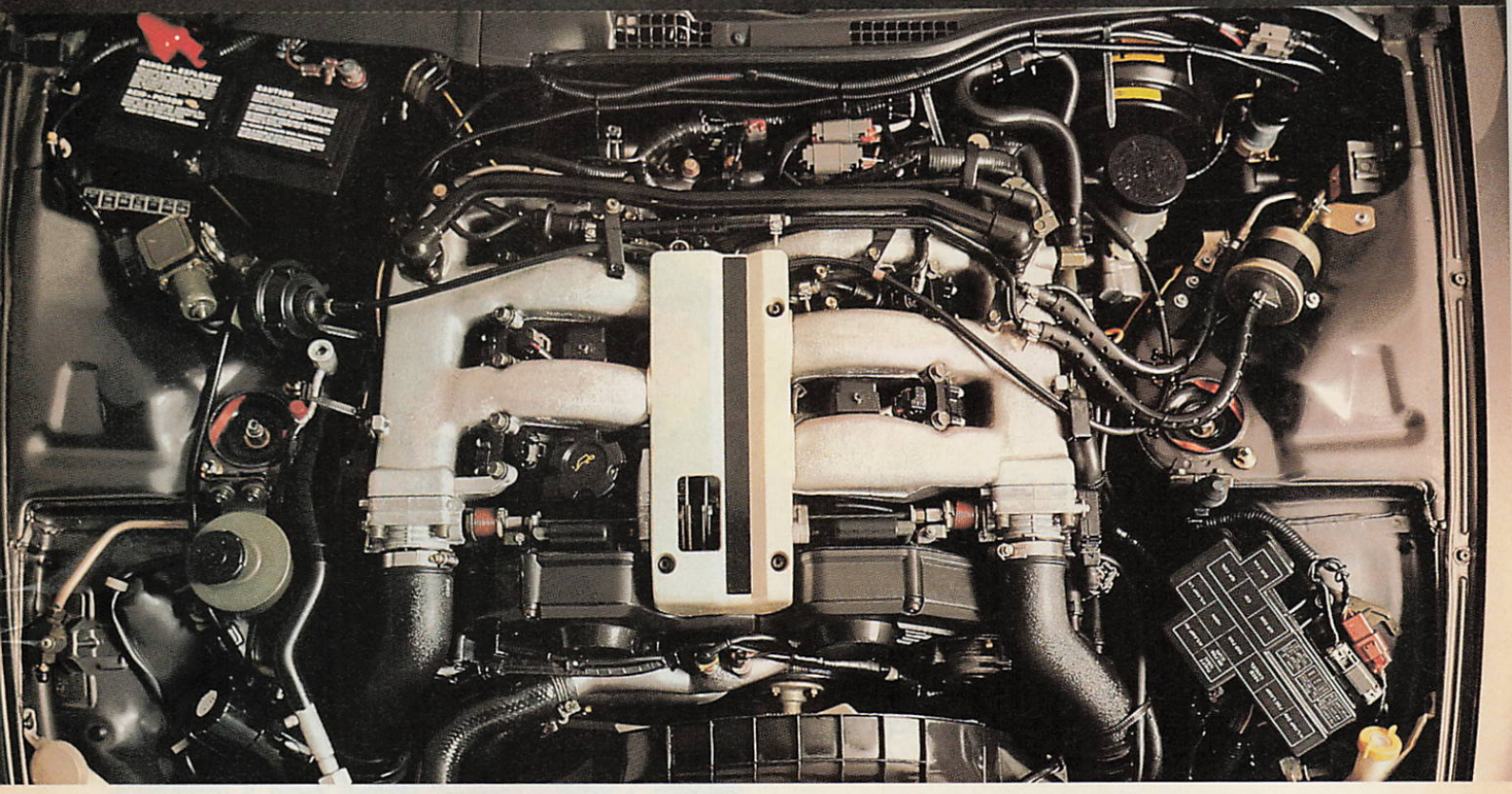

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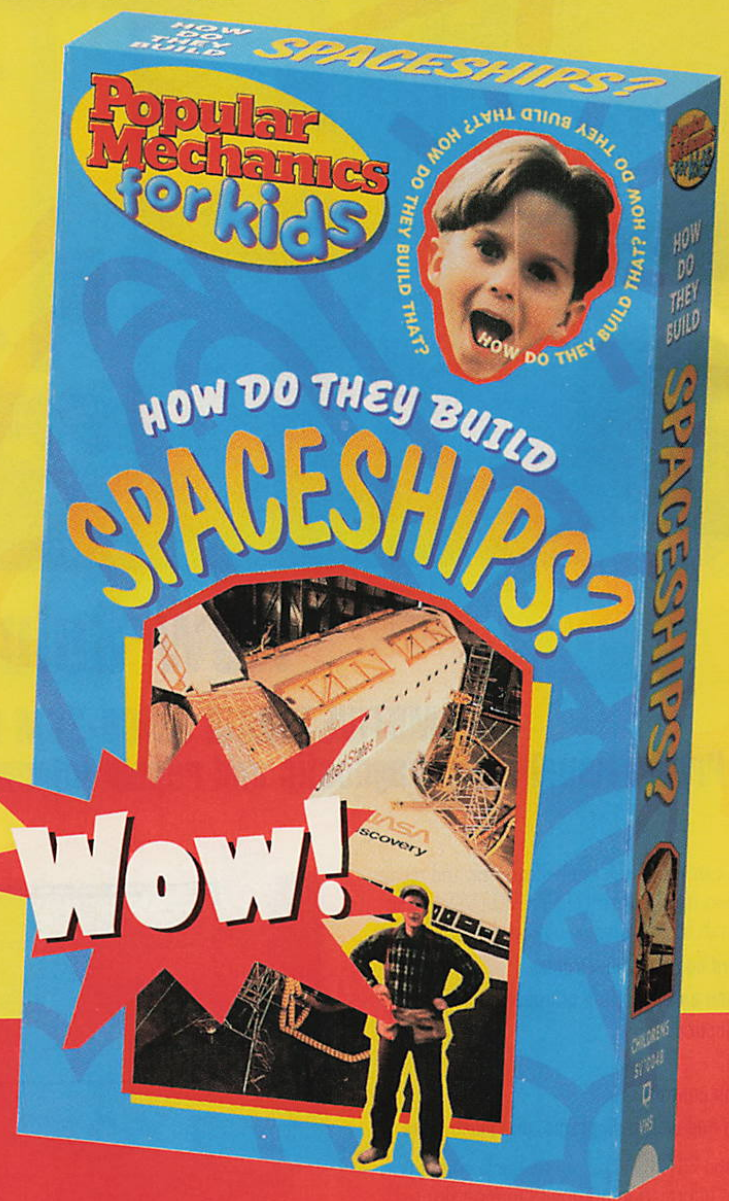

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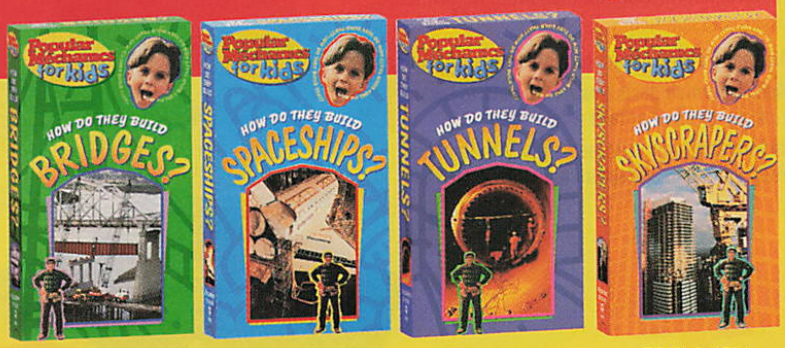

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After a rainstorm we noted a buildup of moisture on the inside of the right headlight lens. We tried the home remedy of leaving the high beams on for an extended time (35 minutes). That took care of the moisture directly in front of the high beam, but more remained.

Finally, the inside door handles suck outside air in a stream. The flaw is especially severe when a window is cracked. Yes, you don't often open a window in cold weather, but when you do, the air leak flows directly on the left side of the driver. Thank goodness spring is here.

—Jim Dunne

Cadillac Catera

Our Cadillac Catera long-term test came to an abrupt, rather ignominious end one recent night on West End Avenue in New York City. The driver of a GMC Safari van tried to defy all laws of physics by having his van occupy the exact same space as was currently being occupied by our Catera. Needless to say, the laws of physics were proven immutable once again. The Catera suffered major right rear quarter damage. As we were in the eleventh month of our 12-month test, we called it a day.

Test Summary: Cadillac Catera
Report number: 4
Total miles driven: 18,790
Miles driven since last report: 2346
Average fuel economy: 18.90 mpg
Worst observed fuel economy: 16.96 mpg
Best observed fuel economy: 22.45 mpg
Maintenance/repair costs: Scheduled 15,000-mile service, $33.96; bodywork, $3695

Too bad, because we thoroughly enjoyed our time with the Catera. Yes, there were a few times we wished for a little more power. But overall, the power, ride and handling offered a well-balanced package that is hard to beat in the class.

In the end, it was the Catera's most dominant characteristic—its excellent handling—that kept the incident from being a major catastrophe rather than just a fender bender. The car's responsive steering and handling allowed us to almost avoid the whole thing. Almost.

In retrospect, handling is what the Catera is all about. You want to fling it around and it wants you to. In fact, the handling is as good or better than anything else you'll find in the entry-luxury segment. If you're in the market for an entry-luxury sedan, you must put Catera on your consideration list.

—J.O.

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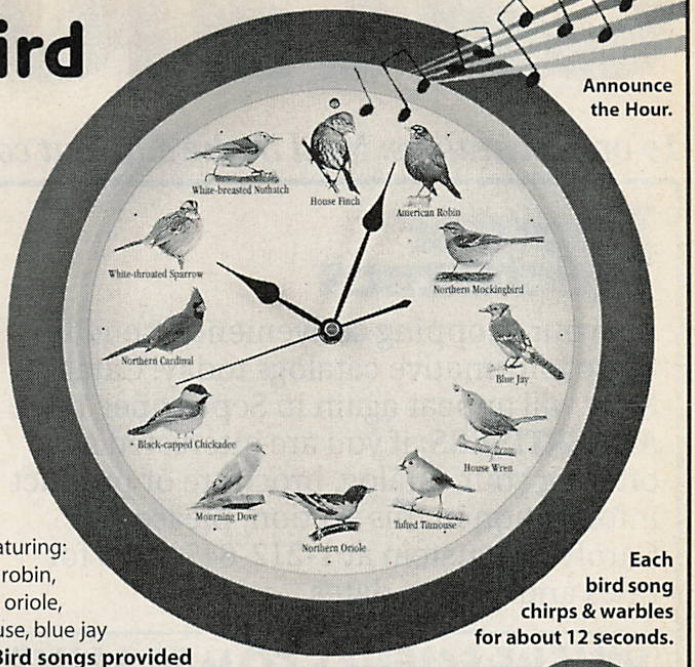

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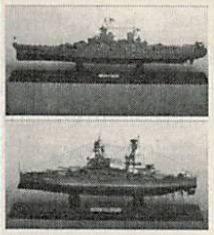

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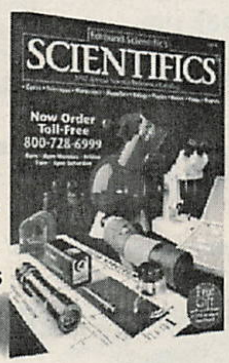

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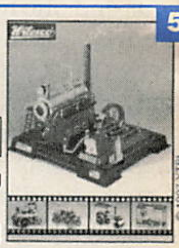

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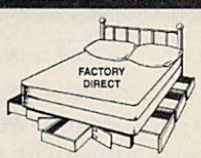

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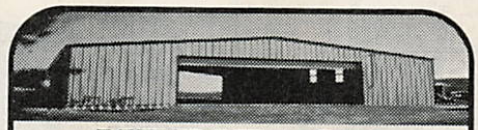

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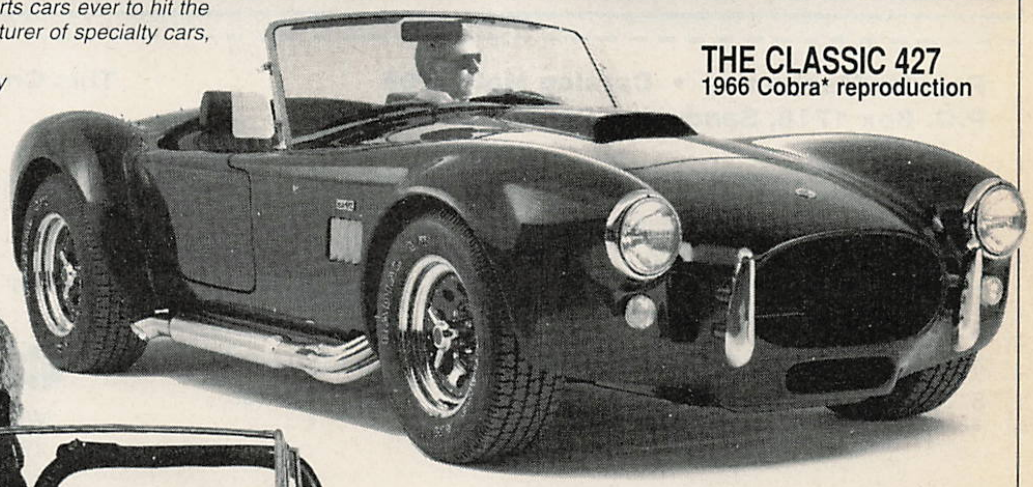

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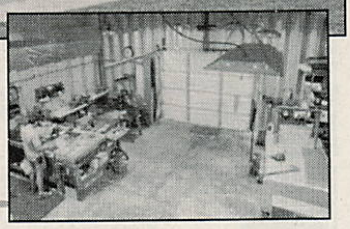

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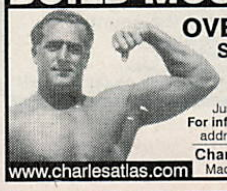

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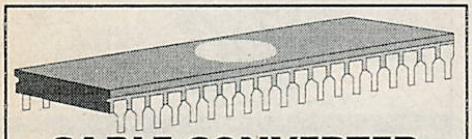

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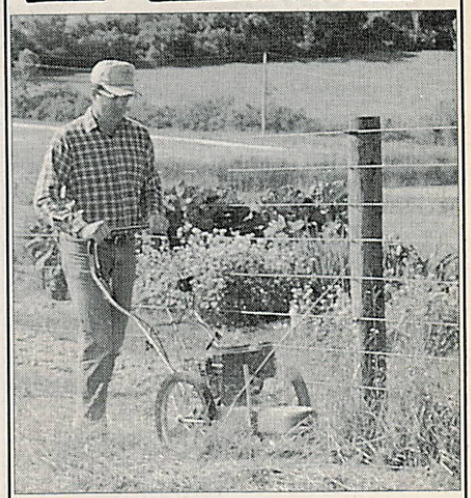

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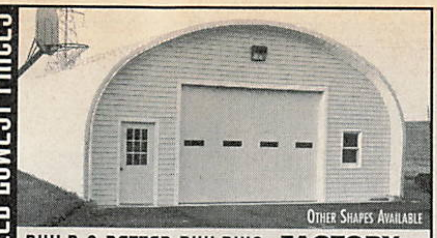

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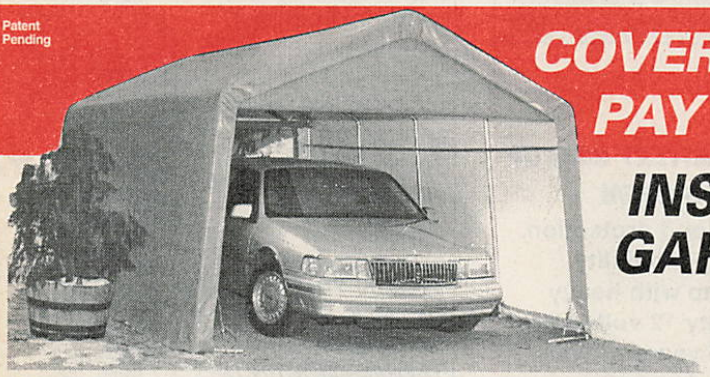

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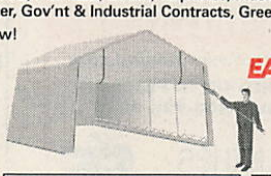

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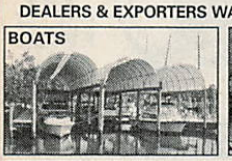

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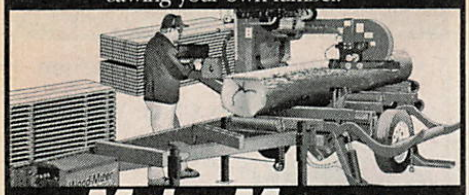

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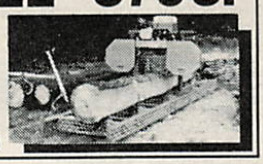

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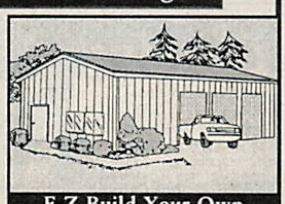

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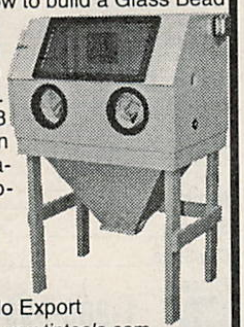

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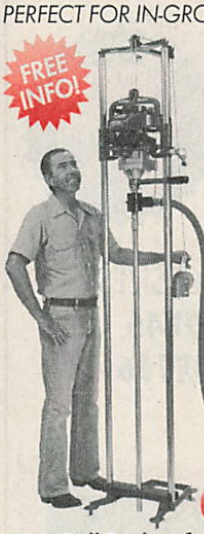

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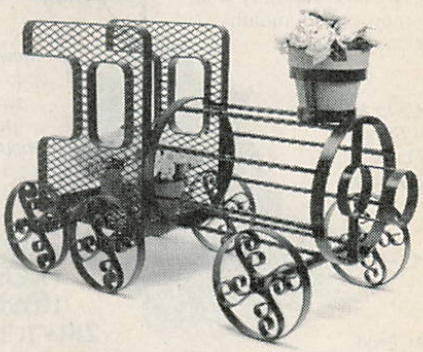

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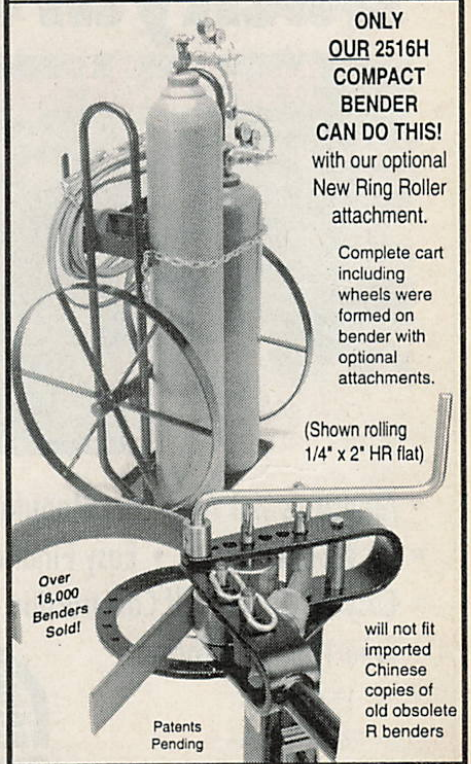

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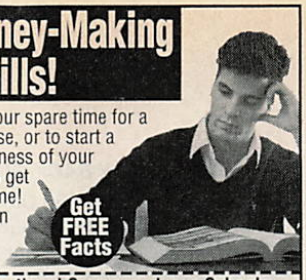

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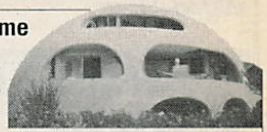

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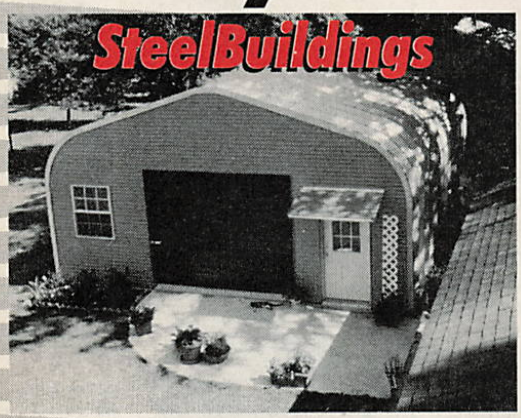

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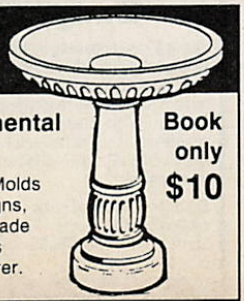

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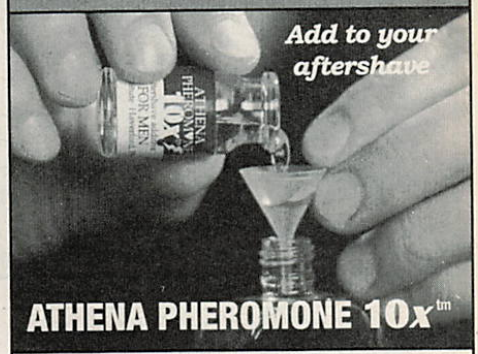

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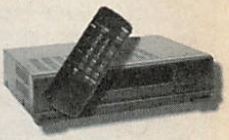

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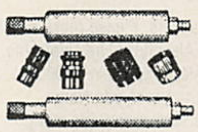

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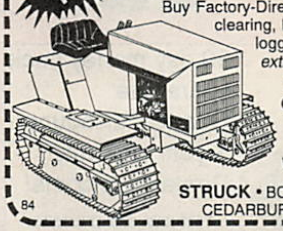

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Last Page

Think It's New? Think Again!

BY MARY SEELHORST

PRESENT

Chrysler introduced the Minivan in 1984 and took a bow for inventing a new type of family vehicle.

The ancient conundrum, "Which came first, the chicken or the egg?" has been replaced with "Which came first, the soccer mom or the minivan?" With the sale of the first minivan in 1984, Chrysler unknowingly spawned a future identity crisis for consumers savvy enough to know the difference between the demographic group they want to be in and the one they are really in.

After a decade of driving minivans in comfortable anonymity, suburban women across America woke up one day in 1996 to find that, through an accidental convergence of vehicle choice, children, sport and election year politics, they had become part of the hottest demographic appellation since "yuppie"—the "soccer mom."

So which did come first, the vehicle or the market segment? Read on.

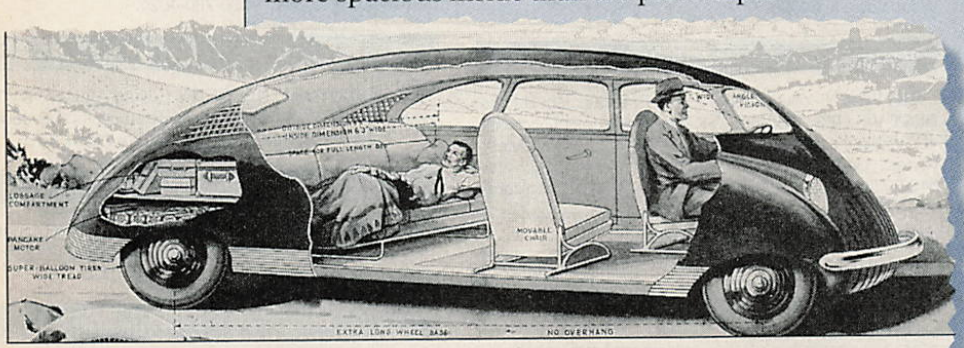
PAST

William Stout introduced the Scarab in 1932 and gave himself a pat on the back for inventing a new type of vehicle.

Living Room On Wheels

If you thought minivans were an invention of the 1980s, think again! Sometimes the vehicle comes long before the market segment.

Though "Scarab" never became a household word, it anticipated today's minivan in form and function. Its designer and engineer, William B. Stout, described it for POPULAR MECHANICS in 1942 as "bigger than a Buick, more powerful than a Cadillac, better riding than any previous car, yet 50% more economical, 50% lighter in weight and 50% more spacious inside than are present passenger vehicles."



An inveterate tinkerer, mechanic, inventor and promoter, Stout was best known for developing the famous Ford Tri-Motor airplane. He applied his aircraft experience to building this elegant, beetle-shaped "living room on wheels." The radical design might never have been produced even in good times, but the Great Depression and the following war ensured that the Scarab never reached its market.

Inside, the Scarab anticipated many of the features of today's minivan. Lots of headroom, movable seats, a fold-down table, and a large rear bench seat made it flexible and functional. With a space frame, no chassis and a rear-mounted Ford V8 engine, the Scarab is still a dream to drive. I know, because I got to drive one of the few remaining Scarabs in 1994. Now, does that make me a soccer mom? Only my demographer knows for sure. **PM**

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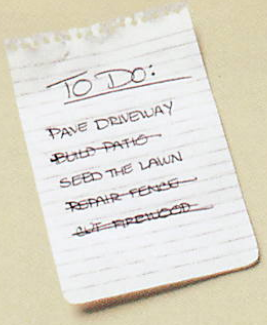

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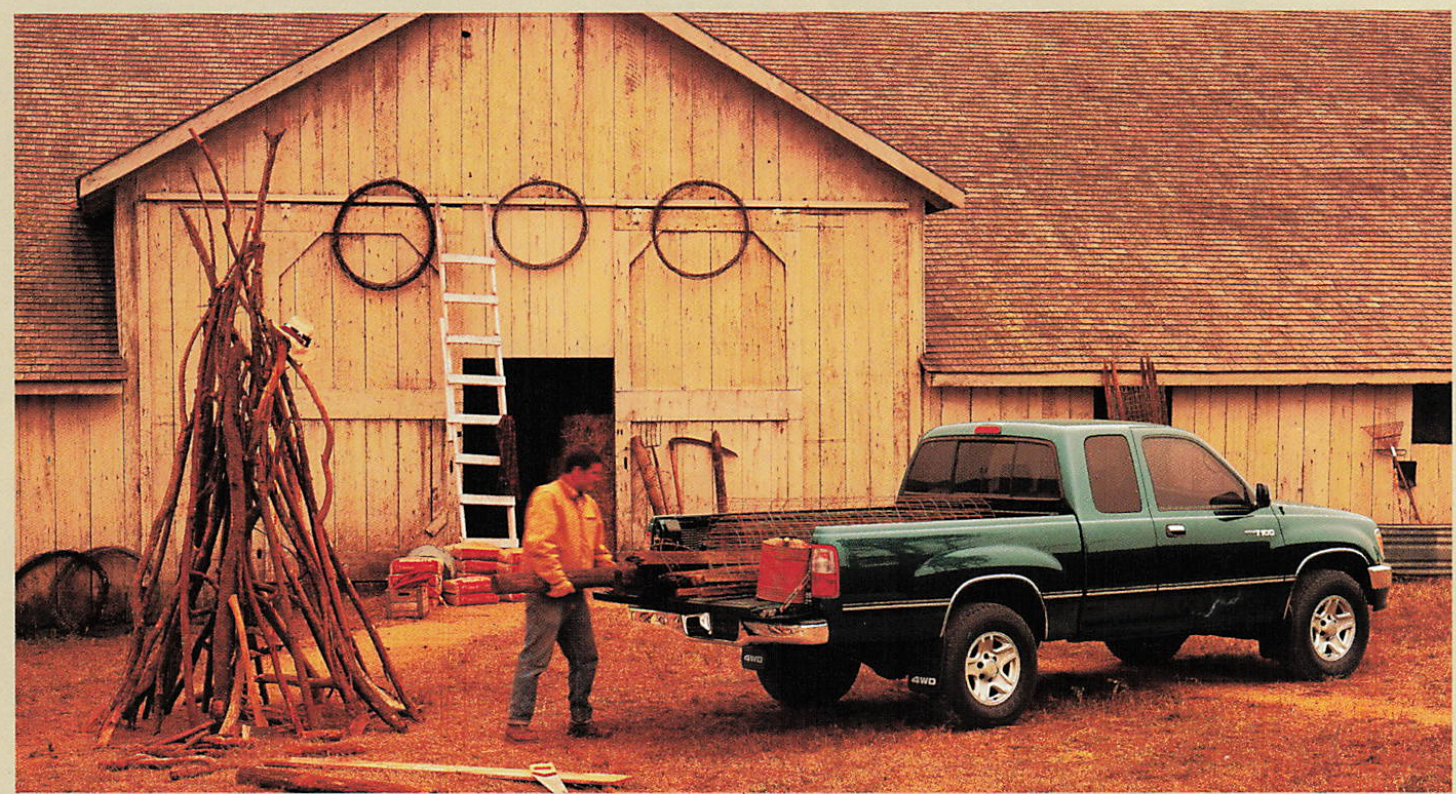

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